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Bulletin of the Wisconsin Natural History Society

Wisconsin Natural History
Society, Milwaukee Public Museum

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BULLETIN

OF THE

Wisconsin Natural History Society

VOLUME I

(NEW SERIES)

WITH SIX PLATES

MILWAUKEE
1900

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PLACE OF MEETING.

LECTURE ROOM, Third Floor of Milwaukee Public Museum.

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OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. I, New Series. JANUARY, 1900. No. I.

Proceedings of the Wisconsin Natural History Society.

March 8 to October 26, 1899.

WEDNESDAY, MARCH 8, 1899.

Called to order at the lecture room of the Public Library by the president, Dr. Geo. W. Peckham.

Chas. H. Doerflinger was elected secretary pro tem.

A letter was then read by Mr. Doerflinger, from Chas. E. Brown, president of the Milwaukee Natural Science Association, announcing that the latter association was disposed to join the Natural History Society, as a body—all its members wishing to become members of the Wisconsin Society. A motion passed to recommend to the board of directors that they be admitted as regular members and that their fees be fixed at $1.20 a year, for the first three years after admission.

Mr. Doerflinger then moved that the Natural History Society, in consideration of its inactivity during several years, amend its constitution by adding to article 6 the clause:

The board of directors are authorized to suspend, remit, or reduce, membership fees whenever in its judgment there are good reasons for such action.

The motion was seconded and carried.

THURSDAY, APRIL 27, 1899.

In the lecture room of the Public Library, with Dr. Peckham in the chair.

The board of directors reported that the following members of the Milwaukee Natural Science Association, which had resolved to unite with the Wisconsin Natural History Society, had been admitted to membership, this being the only constitutional means of uniting the two organizations, viz.: Chas. E. Brown, W. J. Bennetts, Robt. O. Wanvig, Paul H. Dernehl, H. Altschwager, Carl Boerner, Lee W. Whitney, Edw. W. Perkins, Armin Neitzke, Henry Roemheld, Geo. Shrosbree, Paul C. Rohde, Adolf Sontag, F. Kirchner and Frank H. Wallschlager.

The action of the board of directors was approved, and the union of the younger with the older society welcomed by the president.

The board of directors then reported the following resolutions for adoption:

Resolved, That the president and secretary request the board of trustees of the Public Museum to grant the use of the lecture room of that institution, free of charge, for the meetings of the Wisconsin Natural History Society and its sections, and also to grant those members of the society, who are interested in any branch of natural history or ethnology, the privileges accorded by such institutions, in all parts of the world, to students and investigators.

Resolved, That the society place its library, to be acquired by purchase, exchange, or donation, at the disposal of the museum as a loan collection.

Resolved, That the board of directors encourage and facilitate to the extent of the means of the society the organization of sections, which shall make it their object to stimulate study and research in the various branches of natural history.

Resolved, That each section thus formed shall have certain days of each month set aside for its section meetings.

Resolved, That every section shall be represented at the monthly meetings of the society, by its chairman or some other member selected by him, to report on the work and transactions of his section for the preceding month.

The above resolutions were unanimously adopted.

The president then appointed Messrs. Chas. H. Doerflinger, C. L. Mann and C. E. Brown, as a committee to nominate officers for the ensuing year. After a short recess the committee, through its chairman, C. H. Doerflinger, reported the following nominations:

For President—G. W. Peckham.
Recording Secretary—W. J. Bennetts.
Corresponding Secretary—Lee W. Whitney.
Treasurer—Ferdinand Meinecke.
Librarian—Paul H. Dernehl.

DIRECTORS OF SECTIONS:

Zoölogy—Sub-Section Entomology	Chas. E. Brown
Zoölogy—Sub-Section Ornithology	Geo. Shrosbree
Botany	Henry Roemheld
Ethnology	Chas. H. Doerflinger
Mineralogy	Louis Lotz
Geology and Palæontology	E. E. Teller

A motion to elect the nominees mentioned by acclamation was carried unanimously.

Chas. H. Doerflinger then read a paper and made remarks on his "Prehistoric Rambles in France," dwelling principally on the researches, discoveries and collections of his friend, Dr. François Daleau, of Bourg sur Gironde, made in the cave called Pair non Pair, and which he considered the most interesting and important of recent archeological finds. In it are found remains belonging to each of the four principal periods of the paleolithic age in France, viz., the Acheuléen, the Mousterien, the Solutréen and the Madelainien, which correspond to at least four great glacial periods and indicate an age estimated at from 30,000 to 90,000 years.

Mr. E. E. Teller then read a paper on the "Geology and Palæontology of the Region Around Milwaukee," a district he had personally investigated for many years, and in which he had made large and valuable collections. Several of the fossils described in the paper were stated to be new to science and hitherto undescribed.

THURSDAY, MAY 25, 1899.

This meeting was called to order by President Peckham in the lecture room of the Public Museum, eighteen members of the society being present.

The secretary read a report of the first field day of the united sections of the society. The excursion was made to the vicinity of the cement quarries on the upper Milwaukee river, and the report covered the ethnological, ornithological, botanical and entomological aspects of the trip.

Mr. E. E Teller then exhibited a number of fossils collected that day at the quarries, and explained their significance to the meeting. One specimen represented the chamber of habitation of an undescribed cephalopod. Among the others were scales of an undescribed fish, also gonotites, and a tooth of Paleomylus Greenei, named in honor of the late Thos. A. Greene, of Milwaukee.

Dr. Peckham then related some observations made during a recent trip to Georgia. He had found plant life there about a month ahead of that in Wisconsin, but insect life, on the contrary, not correspondingly forward. Spiders and their webs were exceedingly scarce. A new fact in regard to the tortoise shell or Cassia beetle had there come to his notice. A specimen he had captured had changed immediately from yellow-gold to a yellow-red in color, in which state it almost exactly resembled the two-spotted lady bug, regaining its usual color when left undisturbed. As the lady bug is an insect, especially distasteful to birds and lizards, the doctor suggested that the above fact might be an instance of protective mimicry in the Cassia beetle.

Mr. C. E. Brown also mentioned an experience of his in which the same change of color had taken place immediately after they had died, when put in a cyanide bottle.

Mr. Phillip Wells read a paper describing an excursion made the previous Sunday through three miles of woodland, near Elm Grove, Wis., in search of morrels and mushrooms. About thirty species of flowers were mentioned as being observed on the trip. The event of the day was the finding of a flower of the showy *Orchis* (*Orchis spectabilis*)—a flower which Mr. Wells said was identical in structure with the orchid (*Orchis mascula*) figured by Chas. Darwin in his work, "The Fertilization of Orchids."

The following were elected to membership: Mr. Chas. E. Monroe, Mr. W. P. Caine and Mr. Herbert Clowse.

Mr. F. Rauterberg was transferred from the list of active members to the honorary list, and Prof. Marshall, of the University of Wisconsin, was made an honorary member of the society.

The question whether grooved stone axes were peculiar to Wisconsin was brought up by C. E. Brown, and both he and Mr. Ellsworth stated they had so far been unable to find any evidence to the contrary.

THURSDAY, JUNE 22, 1899.

In the lecture room of Public Museum, Dr. Geo. W. Peckham in the chair, and twenty-five members present.

Mr. C. H. Doerflinger, the director of the ethnological section, read the report of a survey that had been made during the week, of the Indian mounds near the cement works, north of the city, and also exhibited photographs of the locality. Mr. Doerflinger stated that he had had access to the unpublished papers of the late Dr. Lapham, author of the "Antiquities of Wisconsin," but could find no evidence that the latter had ever known of the existence of these mounds. Later in the meeting a letter to the same effect from Miss Mary J. Lapham, of Oconomowoc, was read by Mr. E. E. Teller.

Mr. Doerflinger also gave notice that the members of his section would meet the following Sunday for the purpose of excavating a supposed burial mound that formed one of the group.

A paper on the winter habits of the great northern shrike (*Lanius borealis*), was read by Mr. W. J. Bennetts. The paper dwelt particularly on the little known musical ability of this bird and also on its habits as a bird of prey.

Mr. Chas. E. Brown as director of the entomological section read a list of lepidoptera, collected by members of his section during a trip taken to Larkin's tamarack swamp, near North Greenfield, following which he also gave an account of his investigations concerning the depredations of the cottony maple scale (*Pulvinaria innumerabilis*), in this city. He had found them to a greater or less extent in all sections of the city, but especially numerous in a district about a mile square on the West Side. The trees infested were principally the soft maple, the box elder, the balm of Gilead, and the elm, in about the order mentioned, and he had also found them on the grape vine. The life history of the insect was dwelt upon and remedies against its ravages suggested—the kerosene emulsion being the one most recommended.

The president next drew the attention of the society to the late Mr. F. S. Perkins' "Album of Antiquities," now in course of publication, and a motion, endorsing the work as a valuable contribution to archæological science was unanimously carried.

It was also decided that the proceedings of the society should be published at suitable intervals, and the president, the recording secretary and Mr. E. E. Teller were appointed a committee to gather information and report at the next meeting.

The following were elected members of the society: Dr. S. Graenicher, Mr. P. Wells, Mr. John A. Brandon, Mr. T. J. Pereles, Judge J. M. Pereles, Mr. Geo. Sutton, Mr. F. L. Hornseffer, and Mr. Geo. G. Phillips.

It was decided to discontinue the meetings during the warm summer months and to hold the next regular meeting in September.

THURSDAY, SEPT. 28, 1899.

The meeting was held in the lecture room of the Public Museum, with Mr. E. E. Teller in the chair.

An interesting paper on "Indian Dialects of the Algonquins," was read by Mr. D. W. Fowler. It was explained that the term Algonquin related rather to a particular Indian language than to a group of tribes or nations. In the paper, many local names of Indian origin, such as Milwaukee, Wisconsin, Michigan, were traced back to their Chippewa derivation, and the peculiarities of this language were described in detail. Among these are the exceedingly long words, ten or more syllables in length, the large proportion of verbs, comprising about nine-tenths of all the words in the language, the lack of any distinction for sex, and the great regularity of its grammar, there being only two irregular verbs in it.

The Dakotah tongue was also considered, and the statement made that the origin of all Indian languages was wrapt in complete mystery.

Mr. Paul H. Dernehl then read a paper relating his observations on the recent migrations of the milkweed butterfly (*Anosia plexippus.*) The main flight appears to have taken place on the night of Sept. 6th, as on the evening of that day the trees at Lake Park were weighted down by immense numbers of the insects, while on the following morning but few were to be seen.

In discussing this paper, Mr. Chas. E. Brown mentioned flights of this butterfly that had been reported from Pewaukee, Wis., and from Chicago, and also as having been seen crossing an arm of Lake Michigan near the Michigan shore.

Mr. E. Bruncken read a paper entitled, "Some Remarkable Trees in the Vicinity of Milwaukee." The largest tree in this locality was stated to be a soft maple twenty-one feet, eleven inches in circumference, growing on the west bank of the Menomonee River near the Soldiers' Home grounds. This was also, as far as he could discover, the largest soft maple on record.

E. E. Teller informed the society of the finding of an almost complete jaw of the fossil fish *Dinichthys pustulosus,* at the cement quarry, by Chas. E. Monroe.

The resignation of Chas. H. Doerflinger as director of the ethnology section was reluctantly accepted, and L. C. Whitney elected to succeed him.

A report from the treasurer, Mr. F. Meinicke, showed that there were $189.63 in the treasury.

Messrs. Geo. A. West, Otto Habhegger and Richard Raasch were elected to membership in the society.

THURSDAY, OCTOBER, 12, 1899.

This was a joint meeting of the Botany and Ornithology sections, held for the purpose of deciding upon a program for the winter's work. Chas. E. Brown occupied the chair.

The object of the meeting was quite thoroughly discussed by those present, and it was the general opinion that, in addition to the special lines of research in which individual members were interested, considerable attention should be given to our local flora and avifauna.

Mr. P. Dernehl spoke on bird migration, and also described a recent visit to the Field Columbian Museum at Chicago.

Henry Roemheld signified his intention of resigning as director of the Botanical section, and a motion passed to recommend to the society the electing of Ernest Bruncken to the vacancy.

THURSDAY, OCTOBER 26, 1899.

The general meeting for October was held this day in the lecture room of the Public Museum. President Peckham occupied the chair, and eighteen persons were present.

The report of the committee on publications was read by the secretary.

It was voted that the report be adopted and that the selection of the members of the editing committee be left to the president.

Ernest Bruncken was elected director of the Botanical section in place of Henry Roemheld, resigned.

Mr. Bruncken then read a paper entitled "Notes on the Distribution of Some Trees and Shrubs in the Vicinity of Milwaukee." The paper dealt principally with the present distribution of the members of the birch, beech, poplar and willow families in Milwaukee county.

A suggestion of Mr. F. Meinecke that the society give one or more popular lectures on natural history during the coming winter, was favorably considered by the society, and the president and Ernest Bruncken were appointed to make the necessary arrangements.

President Peckham described some recent experiments made by a gentleman of Chicago, upon passenger pigeons, mud puppies and other animals, and which tended to prove that certain facts were not due to any defect in the vision of these creatures, but rather to their inability to recognize familiar objects when the latter were placed under unusual conditions.

Mr. Bruncken described a method of collecting data for a new list of plants of Milwaukee county, by the use of blank cards to be distributed among the active botanists of the locality, and the expenditure necessary for the printing of these cards was authorized by the society.

Messrs. Paul Jerome Waterous, A. W. Slocum and David Whitaker were elected to membership.

There being no further business to transact, the meeting was adjourned.

WILLIAM J. BENNETTS, Secretary.

Report on the Teller Effigy Mounds in Milwaukee County, Wisconsin.

By C. H. DOERFLINGER and C. E. BROWN.

This interesting group of ancient works was first introduced to the notice of the Wisconsin Natural History Society in May, 1899, by Mr. Edgar E. Teller, a member, in whose honor the society has named them. It owes much of its present importance to the fact that Wisconsin's celebrated antiquarian, Dr. Increase A. Lapham, did not note and describe them in his immortal work on Wisconsin antiquities, although it is well known that he very frequently visited the vicinity and described other less extensive groups in the near neighborhood.

Writing to the society under date of June 1st, 1899, his daughter, Miss Mary J. Lapham, expresses her great surprise that her father should have overlooked such an extensive group of emblematic mounds in a locality with which he was so entirely familiar, but a most careful research among Dr. Lapham's published works and unpublished notes has thrown no light upon the matter under consideration, so that we may safely conclude that these ancient works were once so well hidden among the dense underbrush of the surrounding forest as to escape even the careful scrutiny of this great observer.

Of the many interesting prehistoric effigy and other mounds discovered and described by him and other explorers of Milwaukee County, nearly all have long since been effaced by the growth of the city and the cultivation of the outlying tracts, so that at the present time our group stands almost alone as a monument to the customs and works of prehistoric man in Milwaukee County, Wisconsin.*

A proposition to undertake a thorough exploration of this group of mounds was received with enthusiasm by the members of the Ethnological section. A preliminary excursion having been made to the grounds, and a favorable report presented at the following meeting, the director of the section was authorized to prepare a plan of operations and to engage Mr. F. W. Blodgett, an experienced civil engineer, to make an accurate survey of the mounds and their position relative to neighboring landmarks, the result of which is given here below and illustrated by the three accompanying plates.

---

* "It is claimed that within the limits of the city of Milwaukee stood some of these mounds even as late as 1855." H. L. Conrad's History of Milwaukee.

Location.

The Teller group is located in the northeast quarter of the southeast quarter of Section 5, Town 7 north, Range 22 east, in Milwaukee County, Wis., about one-third of a mile east of the Port Washington road, and about a quarter of a mile from the west bank of the Milwaukee River.

It is situated west of and close to the brink of a ravine, about 200 feet wide at the widest part, and through which a small, clear stream flows in the spring and early summer, being directly tributary to the Milwaukee River.

The general elevation of the tract of tree-covered pasture land surrounding the mounds is about 18 feet above the ravine, 36½ feet above the river and 17 feet lower than the Port Washington road. The elevation of the mounds themselves is from one-half foot to 2½ feet above the surrounding pasture land.

This group (Plate II.) comprises thirty-five large and small mounds and consists of:

First.—Five large effigy or animal forms, which belong to the so-called panther or lizard type.

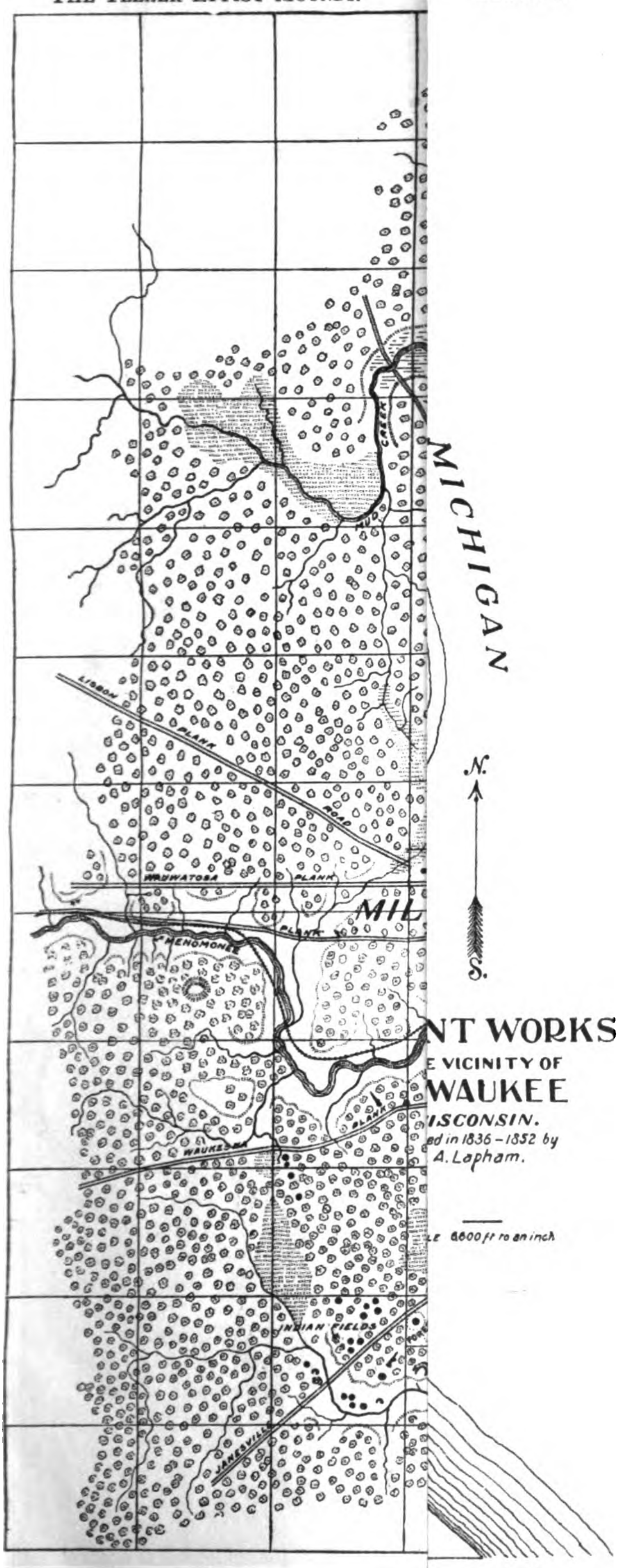
Second.—One large mound of an elliptical shape, which was supposed to have been a burial mound or cache.

Third.—Twenty-seven smaller tumuli of approximately circular or oval outline, of which a group of three accompanies each of the five large effigies, the remaining twelve being located in other parts of the pasture grouped as follows: Six, two, two, one, one.

These smaller mounds are peculiar in their construction, and doubts were expressed during the discussion at meetings of the section, whether they represented the work of the aborigines or merely marked tree falls in the ancient forest. Careful comparison and consideration of these, however, has inclined us to the former opinion. They measure from 18x10 down to 2x6 feet in size, and have each a noticeable depression on either side opposite the transverse axis of the mound, whereas in the case of a tree-mound there would be but one such depression and that directly in the rear of the mound.

These depressions from their situation, give the impression that the mounds themselves were formed by simply scooping out the earth on either side of the mound and heaping it up in the middle. The original oval or circular shape of these smaller mounds appears to have undergone considerable modification in the course of time. It may be remarked that the soil composing these smaller barrows seems to be of a looser nature than that of the effigies.

THE TELLER EFFIGY MOUNDS. PLATE I.



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Five of the larger mounds forming this group, viz., the supposed burial mound and four of the panther or lizard mounds, are quite close together. The supposed "burial mound" (No. 3) being surrounded by three of the effigies (Nos. 1, 2 and 4), while the fifth panther or lizard (No. 6) is isolated from the rest and lies at a distance of about 400 feet in a northerly direction from the remainder of the group. The latter is now somewhat mutilated, having had a considerable portion of its tail removed by the leveling of the ground and erection of a railway spur track directly to the north of it.

Upon this mound and its caudal extremity are to be seen growing three sturdy white oak trees of a circumference of 25, 52 and 36 inches, respectively, measured at breast height from the ground. None of them are probably more than 50 to 75 years old, which, however, is no indication of the age of these mounds, which were undoubtedly, like other mounds discovered in and near Milwaukee by early settlers more than half a century or nearly a century ago, in practically the same condition and of the same appearance when the embryos of those trees first sprouted. This mound measures now about 98 feet 6 inches in length, with an average width of about 7 feet in the tail and 18 feet at the legs.

Mound No. 1 is the largest of the group, with a general course of N. 60 deg. 2 min. W., and measures 162 feet in length, with an average diameter of 9½ feet across the tail and 27½ feet across the body. Its head is about 90 feet from the top of the ravine.

Panther or lizard mound No. 2, the most westerly mound of the group, has a general direction of N. 27 deg. 39 min. W., and is 122½ feet in length, with an average width of 10½ feet across the tail and 25 feet across the body at the limbs.

Upon its western side opposite the legs stands an oak tree 65 inches in circumference.

The distance from the tail end of No. 1 to the head of No. 2 is 40 feet.

Mound No. 3 is the supposed "burial" or elliptical mound. Its center lies about 70 feet north of the middle of the tail of No. 1, about 70 feet to the east of the fore leg of No. 2, and about 80 feet from the middle of the tail of No. 4. It is 55 feet long by 22 feet wide. Its general direction is N. 38 deg. 10 min. W.

Mound No. 4 is located to the northeast of No. 3, and is 119 feet long, with an average width of 9½ feet across the tail and 24 feet across the body. The general direction is N. 63 deg. 30 min. W.

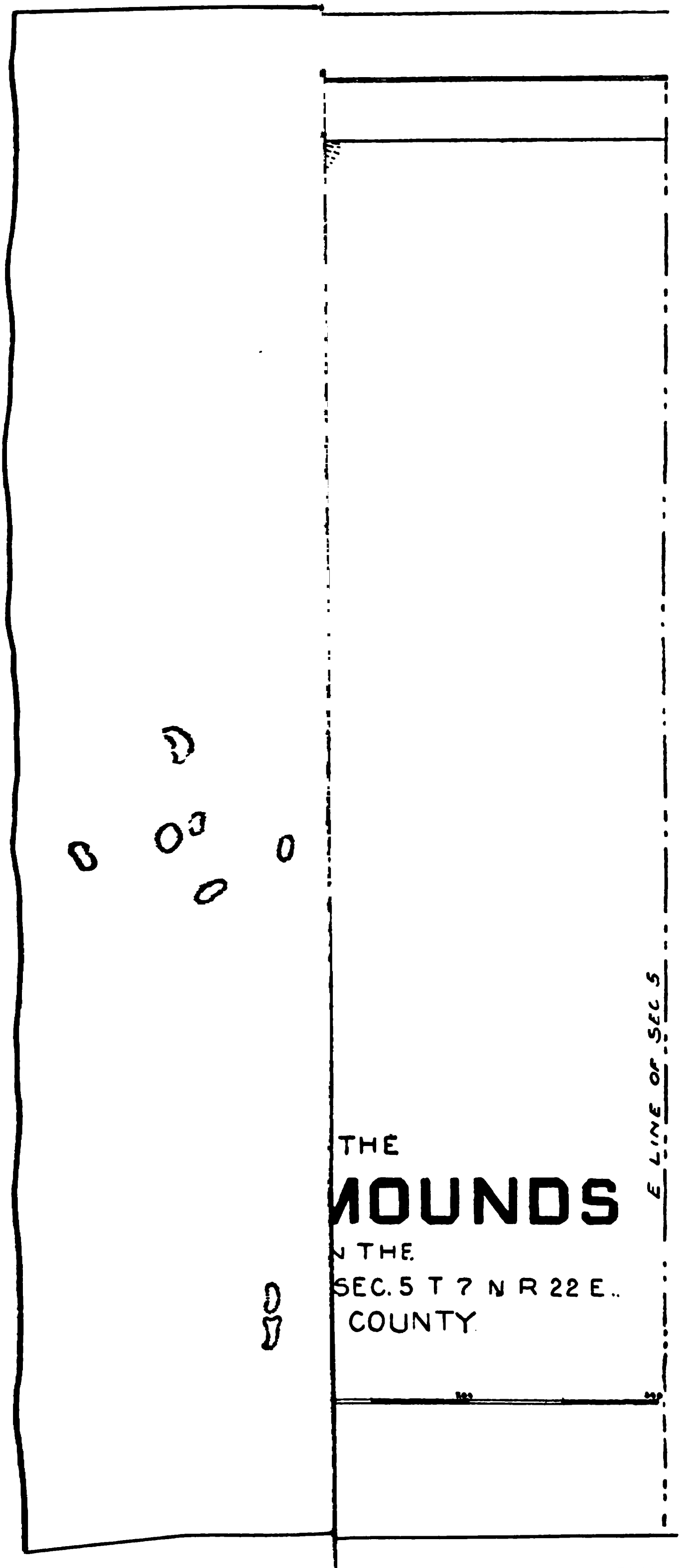
Mound No. 5 is located east by north of No. 4, their middles being about 110 feet apart. Its head projects slightly over the edge of the ravine. It measures 136 feet in length with an average width of 12 feet across the tail and 21 feet across the body, with a general direction of N. 44 deg. 26 min. W.

It is noticeable that all the effigies in this group have their heads directed to the southeast. We do not know what the direction given meant. It may have been a mere whim on the part of the builders or purely accidental; it may have been a sign for other members of the same tribe arriving at the place later, of the direction in which their kin had proceeded; possibly the different poses of the effigies had a meaning known only to the initiated and in this case the key to the picture ciphering will probably never be known. Certain it is that there are very marked variations in the attitudes of the heads and the relative positions of the legs of different specimens of the same species, for instance the so-called panther or lizard.

The learned and indefatigable archæologist, Dr. S. D. Peet, asserts apodictically that our lamented Dr. Increase Allen Lapham was mistaken in calling the effigy that occurs most frequently in this region "lizard." With all due deference to the authority of Dr. Peet, who says it represents a "panther," attention is directed to some matters that may throw light on this question. The effigies in question present a striking resemblance in their proportions to a lizard. The tail is several times as long as the body from head to hind leg; moreover, the tail is like a lizard's, being broad near the leg and gradually tapering to the tip, while the tail of a panther (puma) is comparatively thin, nearly of equal thickness throughout, like a cat's, and is less than two-thirds as long as the body from head to hind leg. One of the Teller effigies carries its head and neck erect, precisely as a lizard does every time it stops after a run, to assume an attitude of attention and observation. While the mound builders may be supposed to have considered the fleet, agile, strong and blood-thirsty panther, their competitor in the hunt and the enemy of their game worthy of deification, it must not be overlooked that lizards, owing to their bright eyes, their speed, their mysterious action in appearing and disappearing like unto a "deus ex machina," and in some cases their rapid mutations of color, were regarded with superstitious awe by most peoples of all ages, whether savages, or more or less civilized, and they play an important role in folklore even at the present day. Nor should it be forgotten that Dr. Lapham was a calm and keen observer; and while no claim of infallibility of judgment is made for him here, we cannot set aside his opinion without conclusive proofs.

On the morning of the 25th of June, 1899, members and friends of the Wisconsin National History Society assembled at the mound field on the grounds of the Milwaukee Cement Com-

THE TELLER EFF PLATE II.



pany, for the purpose of excavating the supposed burial mound No. 3. Trenches from 3 to 4 feet in width, and extending down to the original surface of the ground, were carefully dug from end to end and side to side, but nothing of scientific interest or value was unearthed, the former contents, whatever their nature, had long succumbed to the moisture of the earth and absorbent root growths which have penetrated this mound on all sides. This negative result was anticipated as a possibility or probability, and was therefore no disappointment.

The original surface on which the mound has been erected, is composed of yellow, ochreous clay and gravel, covered with two or three inches of vegetable loam, presenting no appearance of having ever been disturbed. (See plate II.)

At (A) for a depth of about 12 inches is a layer of rich, black loam. At (B) is a layer, about 5 inches in depth, of very black soil of a rather hard consistency when first cut into, having much the appearance of being composed of a mixture of sand and charcoal, which, when exposed to the atmosphere, quickly turns to an ashy grey color, and readily loses its hard consistency. Overlying this at (C) is a layer of black, loamy soil similar to that at (A) and about 24 inches in thickness. The whole is surmounted by a layer of about 3 inches of recent loam. Mixed with the soil in the layers (A and C) were a number of angular fragments of yellow chert, none of them showing, however, the slightest indication of having ever been worked. The only relics that came to light during the excavation, were a small, triangular, incomplete, chipped arrow point of almost white chert, and a bone of about 12 square inches surface that was identified by a physician present as a human cheek bone. Both these objects were found very near the surface by persons not members of the exploring party and their condition gave color to the suspicion expressed as to their antiquity.

Dr. I. A. Lapham, in describing and picturing effigies similar in outline to those comprised in the present group from this and other localities in the state, characterized them as "lizard" mounds, a designation which has subjected him to frequent criticism, even during the period of his own life, and to which he briefly refers in his great work.

It will be noted in regard to the examples of this well-known type in our own and other groups formerly existing in this vicinity, that there is no distinct head visible, the head and fore limbs giving the appearance of having been moulded into one.

Whether this distortion be the work of intention or is merely due to the leveling influence of time and weather, we are only able to conjecture, but the latter assumption seems to have more probability in its favor.

Having given our view on the lizard and panther question, we will quote also opposite holdings.

Dr. S. D. Peet in an article published some years ago in his *American Antiquarian and Oriental Journal,* offers the following kindly criticism of Dr. Lapham's identifications of effigies, which we take the liberty to quote in part:

"* * * Dr. I. A. Lapham published a work over thirty years ago in which animal effigies were shown in great numbers. This work is deserving of great praise as the surveying and plottings are in the main correct."

"He called panthers, lizards and birds, crosses. But other animals he did recognize and the work done by him is worthy of confidence."

There are numerous and weighty reasons why a correct identification of the animals is highly desirable, these have been so well outlined in other publications of note that we will not attempt to repeat them here.

(See *American Antiquarian and Oriental Journal,* pp. 126-199, Vol. VI.)

Suffice it to say that a proper recognition of the animals represented would clear up many disputed points and generally tend to increase the popular interest in the effigies themselves.

We further quote Dr. S. D. Peet as follows, (pp. 187-188, Vol. VI., *Am. Antiq. and Oriental Jour.*). "The (observer) will notice that the animals are represented mainly in motion and in the motion which would be peculiar to the animals inhabiting the different elements.

"1. The lizard and muskrat are represented as crawling or swimming, the birds as flying, and the fish as floating; the three classes corresponding to the three elements."

"These are the different methods of representing this.

"1. The land animals were universally represented with the legs on one side.

"2. The amphibious animals, such as the lizard, turtle and muskrat, are all represented with their legs on both sides, as if in the attitude of swimming.

"3. The birds, on the other hand, all have their wings extended as if in the act of flying.

"4. The fish is represented with the body alone, no particular part of the animal being present."

"The effigies are all good representations of the animal shapes; the attitudes of the animals are also natural, but the manner of representing the different classes of animals is the most worthy of study.

"This is uniform—all the effigies which we have observed have the same characteristics, the manner of presenting the animals having become conventional and fixed."

When we stop to consider that these very birds, beasts and fishes which they so correctly, ably and artistically represented, played a prominent role in their daily life and environments, we need not wonder at their proficiency in depicting them. That they understood to a certain extent the division and classification of the animals they represented is most likely and not at all unnatural under the circumstances.

Such were their natural powers of observation and imitation, strengthened by an every-day association with their subjects, and so great the influence upon their savage nature that they readily became proficient in depicting them in their remarkable earthworks.

The prevalence of the panther type of effigy mound in the state of Wisconsin is well known. Other animals, the eagle, buffalo, wolf, otter and turtle occur frequently, but in point of numbers and relative interest the panther, as becomes his kingliness and strength, readily dominates over all.

Among the animal mounds of Milwaukee County this domination of the panther type over all others is particularly apparent.

Dr. I. A. Lapham alone describes and figures twenty-one of these out of a total of twenty-six animal mounds, the only other animal mounds in Milwaukee County described by him (so far as we are able to ascertain) being three bird, two turtle (one distorted) and one wolf mound.

Mr. Jas. S. Buck in his "History of Milwaukee," describes one other which Dr. Lapham does not seem to have noted, as located, "in Elizabeth Street, now National Avenue, about Twenty-fourth Avenue. This was a gigantic specimen 200 feet in length, and upon it stood oak trees, three feet in diameter."

Dr. Lapham has also spoken of a number of "lizard" and other mounds as having been once located at Walker's Point, on the south side of the Menomonee, near the junction of the Milwaukee and Menomonee Rivers, but does not inform us of their number. If to the twenty-one panther mounds heretofore mentioned we add the five comprised in the Teller group, we have a total of twenty-six panther or lizard mounds out of a total of thirty-one animal effigies described.

Of these nine were known to have been located in the vicinity of or along the Kinnickinnic. two near the Menomonee and twenty-one along the Milwaukee River.

It is a well-known fact, that in the state of Wisconsin, "certain effigies are generally found confined to certain localities, some representing panthers numerously, but other localities representing some other animal with the same prominence."

"A ruling divinity always presides over a locality."

"In one place it may be the eagle, in another the turtle, in another the wild goose, and in still another the racoon or wolf." (pp. 336, Vol. VI., *Am. Antiq. and Oriental Jour.*)

So it appears (if we undertake thus to interpret the hidden meaning of the effigies) that the different clans or gentes of a once great people had each its own particular symbol, which they built into the soil instead of portraying it on their tents, as was the Indian custom.

Totemism has been at some time or other common to the greater number of the wild tribes in all parts of the world, and in North America it once prevailed among the tribes east of the Rocky Mountains, and in Mexico and Central America.

Briefly defined it consists in the reverence or common faith of a body of men and women for an animal or mythological being by whose name they call themselves and from which they claim descent. This totem is common to the whole clan and passes by inheritance from one generation to another.—(*Ency. Britanica.*)

Dr. S. D. Peet in his extensive works and researches has plainly intimated to us that such a system of clan emblems did prevail among the emblematic mound builders, and he has given us many excellent reasons for so thinking.

He has pointed out to us, that where we find a certain region in which one effigy type outnumbers all others, we may rightly adjudge it to have been once the domain of a clan which had that particular effigy for its tribal totem.

By this means he has been able to say with ease and accuracy just what clans occupied a certain territory and the extent of their holdings by the effigies which have survived their downfall.

From him we learn that the turtle clan once occupied a strip of land extending along the Rock River, from Lake Koshkonong to Janesville, through Beloit and Rockford to the mouth of the Kishwaukee River, and possibly from Beloit to Geneva Lake.

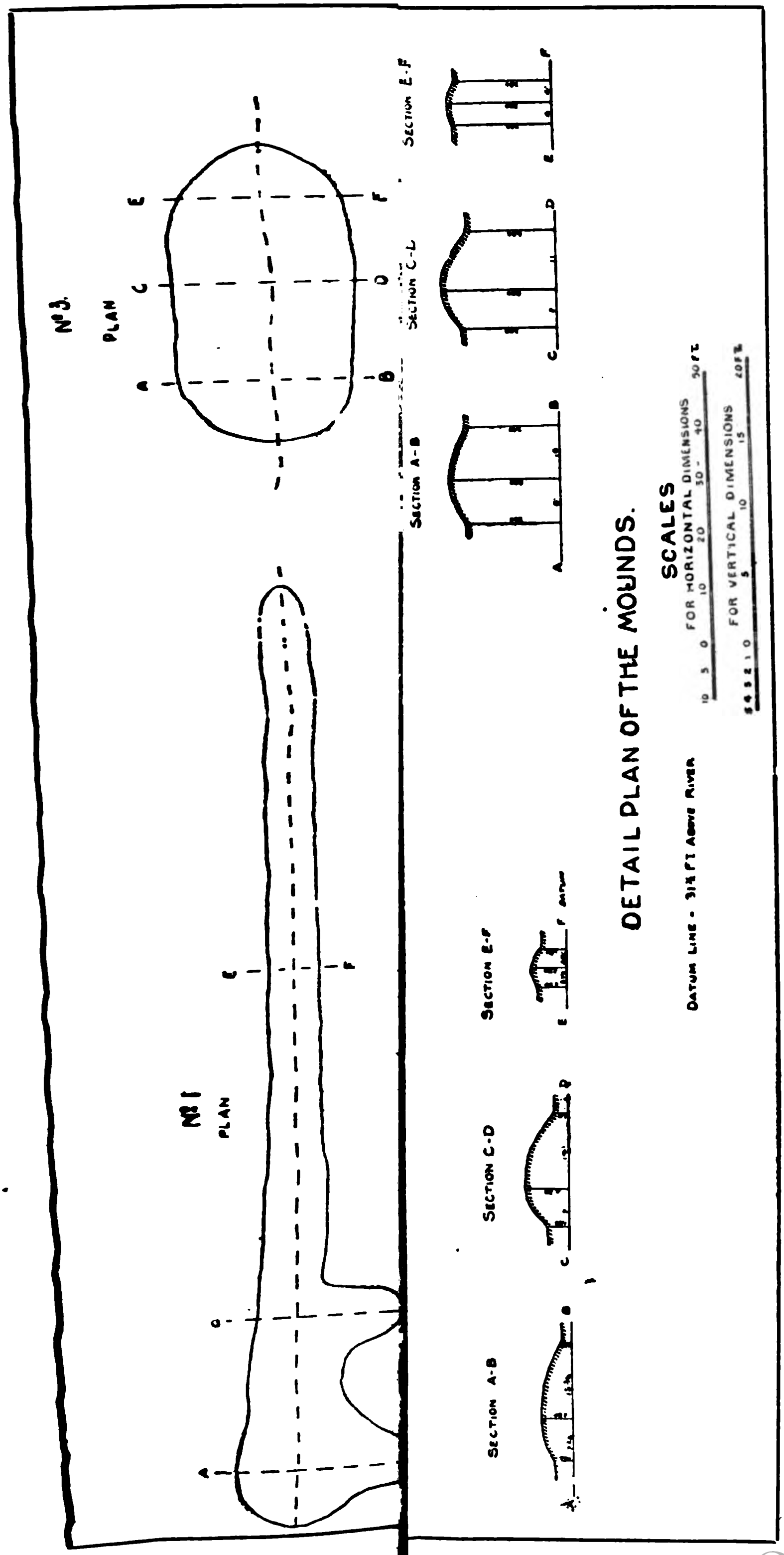
The racoon clan he has located on the Sheboygan River.

The eagle clan extended from near Port Andrews all along the Wisconsin River to Sauk City, crossed over the watershed and finally ends in the region of the four Madison lakes.

The wolf clan he has recorded as occupying territory on the Milwaukee River, and the mink in Adams and Juneau counties.

The panther or lizard clan, one of the largest and strongest as his researches and our own incomplete local estimate will show,

PLATE III.


No. 3
PLAN
A
B
C
D
E
F
SECTION A-B
SECTION C-D
SECTION E-F
No. 1
PLAN
SCALES
FOR HORIZONTAL DIMENSIONS
10 5 0 10 20 30 40 50 FT.
FOR VERTICAL DIMENSIONS
5 4 3 2 1 0 5 10 15 20 FT.
DATUM LINE - 31½ FT ABOVE RIVER
DATUM

DETAIL PLAN OF THE MOUNDS.

occupied the greater part of the land along the three rivers, Milwaukee, Menomonee and Kinnickinnic, in Milwaukee County, and extended on to Racine, in Racine County and west to the Fox River to the great works at Great Bend, and on to Burlington, Wisconsin.

It often happens that two or more types of effigies are to be seen forming part of one group, where two domains overlap each other or where two or more clans occupied the same hunting ground.

This latter may be plainly seen by a glance at the game drive at Crawfordsville in Racine County, lying on the edge of a rice swamp several miles from the village site at Great Bend, of which it is generally conceded to be an out-work, in the territory of the panther clan, and first described by Dr. I. A. Lapham.

The effigies comprising this group are two of the panther, two turtle, three bird and one smaller effigy.

The runways themselves, through which the game is supposed to have been driven, are formed by nearly parallel location of the panther, turtle and oblong mounds, while the birds with wings wide-spread, nicely closed the embrasures at one end, forming a kind of game trap. And again the intermingling of two or more styles of effigies in one group may denote the removal of the original occupants from one point to another through the influence of war or stern necessity.

In either case the invading force might choose and probably did choose to indicate and commemorate its acquirement of new territory by erecting its own effigies near those of its late occupants and probably making them especially numerous and prominent.

What is more likely than that each should have its own clan center of government and population.

That of the panther clan appears to have been located at Great Bend on the Fox River, and others elsewhere. The wonderful works at Aztalan, we are informed, were a clan center or what is more likely by its extent, peculiar construction, centered trails and central location, the capital of a once great nation.

(See S. D. Peet's "Prehistoric America," Vol. II.)

"The attitudes of the animals will be seen not in a single group, but by studying various groups, as all the groups are characterized by the presence of a ruling divinity, one group furnishing one attitude and another another, the whole series giving a history of the divinity or show how varied his moods are."—(Prehistoric America, S. D. Peet, Vol. II.)

Of the many mounds of the panther or lizard type described by Dr. I. A. Lapham and others from this locality, all, with but one or two exceptions, of which we will speak later, are represented in exactly the same general attitude, although the size varies considerably.

This is the most common attitude of the panther.

It has been argued that the prevalence of this type of effigy may indicate the abundance of the panther or mountain lion in this locality during prehistoric times, for though this animal is now rarely or never met with in Wisconsin, it is highly probable that it was once common here. Yet while the abundance of the type may indirectly indicate this, we can scarcely assign it as the only reason for their abundance.

Totemism has both its religious and its social aspect. Sometimes one survives the other.

Hence the religion of some tribes still shows lingering traces of a social system based on totemism, long after its disappearance, and on the other hand the social system often survives the other.

Clan totems have their limitation, being generally restricted to a certain fixed number.

The Seneca branch of the Iroquois tribe was divided into two phratries, each of which included four clans, viz., the bear, wolf, beaver and turtle, forming one phratry, and the deer, snipe, heron and hawk, the other.—(Morgan, p. 90.)

The Mohegans knew subdivision into the wolf phratry with clans, wolf, bear dog and opossum, and the turtle phratry, with clans little turtle, mud turtle, great turtle and yellow eel, and the turkey phratry with clans turkey, crane and chicken.—(Morgan, p. 174.)

Among the mound builders nearly every living class of animals was imitated, the birds of the air, the fishes in the streams and lakes, the beasts of the prairie and wood. The variety of the animals represented is too great for them to have been exclusively tribal signs. Let us then merely glance at the other side, that of the religious character and significance of the emblematic mounds.

These ancient peoples, like many other barbarous tribes and peoples the world over, were true nature and animal worshipers Animal and nature worship being but the earlier stages of idolatry.

What would be more likely or natural than that they, desirous of being ever under the power and protection of their divinities, should imitate them in connection with their villages, fortifications, game drives, places of council and burial, and along their trails, watercourses and other routes of travel.

It was this same pervading superstition that led them in many cases to erect their effigies upon the most prominent points of land, where they could lend their divine power to the entire country about. It would seem that with them the various animals had each its especial rank and place in the religious firmament.

To them the panther with his wonderful strength and agility of body and limb, his courage and ferocity when angered, and his cunning in ambushing his prey, were the embodiment of kingliness and Godship.

The others typifying the minor gods, each possessing its own peculiar virtues and religious significance, were the minor divinities properly in attendance upon the greater.

In this case the panther is used simply as an illustration, the eagle or any other of the larger animals may have been equally highly reverenced by the aboriginal worshipers.

Neither is it altogether probable that the physical traits of the animal alone had to do with its preferment over all others.

Let us ask ourselves next what evidence have we that the Teller mounds may not have enclosed a mound builder village at one time?

Just previous to the occupation of this land by the white settlers and at the time when the United States government purchased this territory from the Indian tribes which inhabited it, the Menomonee Indians occupied the land along the east side of the Milwaukee River and the land on the west side was equally shared by the Pottawattomies, Sacs and Foxes. The country at the mouth of the river had been up to that time occupied in turn by these and other tribes of Indians.

It frequently happened that their villages were situated on the very sites upon which stood mounds of a prehistoric race.

Dr. I. A. Lapham has likewise informed us that the ancient earthworks in this state are usually situated in the very places selected more recently by the Indians for their villages.

Such was the similarity in their wants and habits. Howard Louis Conrad, in his "History of Milwaukee," says: "The rivers which now unite at the mouth of the Milwaukee, the deep bay into which they empty and the marshes surrounding their mouths, furnished the means of gratifying their tastes for hunting and fishing, and the neighborhood was well known to large numbers of them, before a white man knew of its existence."

Dr. Lapham had drawn our attention to the fact "that much time and labor were undoubtedly required for the completion of such large structures, and it would be necessary to accumulate the means of subsistence." "This would require more than a temporary residence," says Dr. S. D. Peet, "especially if we admit that the mounds were built with a view to their utility." The main source of identification of the villages of these emblematic mound builders, lies clearly in their situation.

Such villages, if we may accept the tales and descriptions given by early voyagers and travelers, had no stockades or visible means of defense beyond the natural barriers, ravines, swamps, bluffs and the fastnesses of the dense forest in which they reposed.

It will be noticed that the location of the Teller mounds is just such as would be chosen for the location of a village site.

Located in the midst of a once dense forest filled with game, protected on its eastern side by a ravine, on the north by a formerly-existing morass supplying wild rice, and a river replete with fish, on the south and west by the effigies themselves representing the power of the gods.

There were clear springs in the ravine and probably garden plats or cornfields in the near neighborhood, such as Dr. Lapham has described in connection with other groups he found here.

The location was an ideal one and the spot particularly attractive.

It is quite likely from the small amount of property enclosed (some 20 acres), that the village was not as large or important as some others in the state to which it bears many striking similarities.

Not only is it probable that there was formerly a mound builder village at this point, but it was one of a complete system of villages and their outworks which, if we examine Dr. I. A. Lapham's "Map of Works in the Vicinity of Milwaukee" (republished herewith), we shall find extended up the Milwaukee River Valley from its mouth through Milwaukee and Ozaukee Counties to above West Bend in Washington County.

A pretty good idea of this systematic arrangement of mounds along river systems may be had by glancing at the government archæologic maps of Wisconsin and other states, and noting especially the distribution of works along the Muskingum and other rivers in Ohio, Illinois and Indiana. Such a system would bring the clans into closer communication in war or trade.

It had been intended by this section that an attempt should be made by the society to preserve this last surviving memorial of prehistoric man in Milwaukee County, by recommending its purchase by the city for park purposes, but since the beginning of this publication, vandal hands and relic seekers have again and again dug into and disturbed the tranquility of the effigies, so that now such recommendation would not be acceptable.

Like the unique magnificent works at Aztalan and many other important monuments of the culture of a prehistoric race that once dominated the whilom Northwestern Territory, the Teller group of mounds in Milwaukee County is doomed to destruction and oblivion.

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Jas. S. Buck's "History of Milwaukee."
H. L. Conrad's "History of Milwaukee."
Dr. S. D. Peet's "Prehistoric America," Vol. II.
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"Unnamed Wisconsin," Davidson.

List of Lepidoptera of the County of Milwaukee.

By F. RAUTERBERG.

The following is a list of diurnal lepidoptera collected by me in Wisconsin in the County of Milwaukee, with notes on the frequency of their occurrence.
FR. RAUTERBERG.

[The numbers in the second column correspond with the Check List of Lepidoptera of Boreal America, by Prof. J. B. Smith.]

RHOPALOCERA—Family Nymphalidae.

Wis. No.	Amer. No.	
		EUPLOEINAE.
		DANAIS. Latr.
1	1	Archippus—Fab. Very common.
2	2	Berenice—Cram. Rare.
		NYMPHALINAE.
		EUPTOIETA. Doub.
3	10	Claudia—Cram. Rare.
		ARGYNNIS. Fabr.
4	12	Idalia—Dru. Rare.
5	12 ab	Ashtaroth—Fisher. Very rare.
6	15	Leto—Behr. Common.
7	17	Cybele—Fabr. Common.
8	18	Aphrodite—Fabr. Common.
9	19	Cipris—Edw. Common.
10	20	Alcestis—Edw. Common.
11	53	Myrina—Cram. Common.
12	65	Bellona—Fabr. Common.
		MELITAEA. Fabr.
13	67	Phæton—Dru. Very rare.
		PHYCIODES. Doub.
14	104	Nycteis—Db. Hew. Common.
15	108	Tharos—Dru. Common.
		GRAPTA. Kirby.
16	125	Interrogationis—Fabr. Common.
17	a	Fabricii—Edw. Common.
18	b	Umbrosa—Lint. Common.
19	135	Progne—Cram. Common.
20	136	J-Album—Bd. Lec. Rare.
		VANESSA. Fabr.
21	137	Antiopa—Linn. Very common.
22	139	Milbertii—Gdt. Very rare.
		PYRAMEIS. Doub.
23	140	Atalanta—Linn. Very common.
24	141	Huntera—Fabr. Very common.
25	142	Cardui—Linn. Common.

Wis. No.	Amer. No.	
		JUNONIA Doub.
26	144	Cœnia—Hbn. Rare.
		LIMENITIS. Fabr.
27	156	Ursula—Fabr. Common.
28	157	Arthemis—Dru. Common.
29	a	Lamina—Fabr. Common.
30	b	Proserpina—Edw. Common.
31	159	Disippus—Gdt. Common.
32	a	Floridensis—Strk. Common.

SATYRINAE.

		NEONYMPHA. Westw.
33	177	Canthus—Bd. Lec. Common.
34	181	Eurytris—Fabr. Very common.
		EREBIA Dalm.
35	198	Haydenii—Edw. Rare.
		SATYRUS. Westw.
36	208	Alope—Fabr. Common.
37	208 1-3 b	Texana—Edw. Very rare.
38	208¼	(*Form*) Nephele—Kirby. Rare.

LIBYTHEINAE.

		LIBYTHEA. Fabr.
39	233	Bachmani—Kirtl. Very rare.
40	234	Carinenta—Cram. Very rare.

LYCAENIDAE.

LEMONIINAE.

		CALEPHELIS. G. & R.
41	246	Nemesis—Edw. Rare.

LYCAENINAE.

		THECLA. Fabr.
42	252	M-Album—Bd. Lec. Very rare.
43	258 a	Acadica—Edw. Common.
44	263	Calanus—Hbn. Rare.
		CHRYSOPHANUS. Doub.
45	306	Thoe—Bd. Lec. Very common.
46	312	Hypophlæas—Bdv. Very common.
		LYCAENA. Fabr.
47	352 a	Lucia—Kirby. Common.
48	352 c	Violacea—Edw. Common.
49	352 g	Neglecta—Edw. Common.
50	354	Comyntas—Gdt. Rare.
51	359	Antibubastus—Hbn. Very rare.
52	364	Theonus—Luc. Rare.

PAPILIONIDAE.

PIERINAE.

Wis. No.	Amer. No.	
		PIERIS. Schrank.
53	375	Protodice—Bd. Lec. Very common.
54	376 g	Virginiensis—Edw. Very common.
55	378	Rapæ—Linn. Very common.
56	378 b	Immaculata—Sk. & Aar. Rare.
57	378 e	Nov-Angliae—Scud. Rare.
		NATHALIS. Bdv.
58	379 a	Irene—Fitch. Very rare.
		MEGANOSTOMA. Reak.
59	403	Cæsonia—Stoll. Common.*
		COLIAS. Fabr.
60	408	Eurytheme—Bdv. Common.
61	408 a	Ariadne—Edw. Rare.
62	408 b	Keewaydin—Edw. Common.
63	408 c	Eriphyle—Edw. Very rare.
		TERIAS. Swains.
64	431	Lisa—Bd. Lec. Common.

PAPILIONINAE.

		PAPILIO. Linn.
65	439	Ajax—Linn. Rare.*
66	443	Turnus—Linn. Rare.
67	443 a	♀ Glaucus—Linn. Rare.
68	446	Thoas—Linn. Very rare.
69	456	Asterias—Fabr. Very common.

HESPERIDAE.

		ANCYLOXYPHA. Feld.
70	466	Numitor—Fabr. Common.
		THYMELICUS. Speyer.
71	473	Poweschiek—Park. Common.
		PAMPHILA. Fabr.
72	475	Zabulon—Bd. Lec. Very common.
73	476	Hobomok—Harr. Common.
74	484	Manitoba—Scud. Rare.
75	501	Leonardus—Harr. Rare.
76	504	Nemorum—Bdv. Common.
76	517 a	Egeremet—Scud. Rare.
77	518	Peckius—Kirby. Common.
78	519	Mystic—Scud. Rare.
79	524	Manataaqua—Scud. Common.
80	526	Vestris—Bdv. Common.
81	551	Delaware—Edw. Rare.
		AMBLYSCIRTES. Speyer.
82	565	Samoset—Scud. Common.
		NISONIADES. Speyer.
83	584	Icelus—Lint. Rare.
		EUDAMUS. Swains.
84	616	Pylades—Scud. Common.
85	617	Nevada—Scud. Rare.
86	623	Lycidas—S. & A. Common.
87	627	Tityrus—Fabr. Common.

HETEROCERA.

SPHINGIDAE — Macroglossinae.

Wis. No.	Amer. No.	
		HEMARIS. Dalm.
88	645	Tenuis—Grt. Common.
89	646	Diffinis—Bdv. Common.
90	647	Axillaris—G. & R. Common.
91	649	Thysbe—Fabr. Common.

CHOEROCAMPINAE.

Wis. No.	Amer. No.	
		DEILEPHILA. Ochs.
92	664	Gallii—Rott. Rare.
93	665	Lineata—Fabr. Very common.
		ARGEUS. Hbn.
	667	Labruscæ—Linn. Very rare.
		PHILAMPELUS. Harr.
94	671	Pandorus—Hbn. Rare.
95	672	Achemon—Dru. Common.
		AMPELOPHAGA. Brem & Gray.
96	674	Choerilus—Cram. Very rare.
97	675	Myron—Cram. Common.

SPHINGINAE.

Wis. No.	Amer. No.	
		PROTOPARCE. Burm.
98	688	Celeus—Hbn. Common.
99	689	Carolina—Linn. Common.
100	691	Cingulata—Fabr. Very rare.
		SPHINX. Linn.
101	692	Kalmiæ—S. & A. Very Rare.
102	693	Drupiferarum—S. & A. Rare.
103	698	Libocedrus—Hy. Edw. Very rare.
104	699	Chersis—Hbn. Common.
		CERATOMIA. Harr.
105	714	Amyntor—Hbn. Rare.
106	715	Undulosa—Walk. Common.

SMERINTHINAE.

Wis. No.	Amer. No.	
		TRIPTOGON. Brem.
107	722	Modesta—Harr. Rare.
		SMERINTHUS. Latr.
108	723	Geminatus—Say. Rare.
109	724	Cerisyi—Kirby. Common.
110	724 (2)	(*Form*)—Ophthalmicus—Bdv. Rare.
		PAONIAS. Hbn.
111	725	Excæcatus—S. & A. Common.
112	726	Myops—S. & A. Common.
		CRESSONIA. G. & R.
113	728	Juglandis—S. & A. Rare.
		ARCTONOTUS. Bdv.
114	729	Lucidus—Bdv. Rare.

Wis. No.	Amer. No.	
		SESIIDAE.
		SESIA. Fabr.
115	792	Acerni—Clem. Common.
116	794	Tipuliformis—Linn. Very common.
		AGARISTIDAE.
		ALYPIA. Hbn.
117	881	Octomaculata—Hbn. Very common.
		COPIDRYAS. Grt.
118	897	Gloveri—G. & R. Rare.
		EUDRYAS. Bdv.
119	898 a	Brevipennis—Stretch. Common.
120	899	Grata—Fabr. Rare.
		SYNTOMIDAE.
		LYCOMORPHA. Harr.
121	912	Pholus—Dru. Rare.
		CTENUCHIDAE.
		SCEPSIS. Walk.
122	932	Fulvicollis—Hbn. Common.
		PERICOPIDAE.
		MELANCHROIA. Hbn.
123	952	Cephise—Cram. Very Rare.
		NYCTEOLIDAE.
		SARROTHRIPA. Curtis.
124	962	Lintneriana—Speyer. Rare.
		LITHOSIIDAE.
		NOLA. Leach.
125	966	Fuscula—Grt. Rare.
		CLEMENSIA. Pack.
126	973	Albata—Pack. Rare.
		CRAMBIDIA. Pack.
127	976	Pallida—Pack. Common.
		HYPOPREPIA. Hbn.
128	977	Fucosa—Hbn. Common.
		LITHOSIA. Fabr.
129	986	Bicolor—Grt. Rare.
130	987	Cephalica—G. & R. Rare.
		EUPHANESSA. Pack.
131	996	Mendica—Walk. Common.
		AMERIA. Walk.
132	998	Unicolor—Rob. Common.

ARCTIIDAE.

ARCTIINAE.

Wis. No.	Amer. No.		
		CROCOTA. Hbn.	
133	1008		Ferruginosa—Walk. Rare.
134	1017 (1)		*Treatii*—Grt. Common.
		UTETHEISA. Hbn.	
135	1020		Bella—Linn. Common.
136	1020 a		Hybrida—Butl. Rare.
137	1020 b		Pura—Butl. Rare.
		CALLIMORPHA. Latr.	
138	1024 a		Militaris—Harr. Common.
		ARCTIA. Schrank.	
139	1034		Virgo—Linn. Common.
140	1038		Rectilinea—French. Common.
141	1058		Decorata—Saund. Very rare.
142	1059		Nais—Dru. Common.
143	1059 a		Phalerata—Harr. Common.
144	1060		Anna—Grt. Common.
145	1060 a		Persephone—Grt. Common.
146	1061		Virguncula—Kirby. Common.
147	1065 a		Dione—S. & A. Common.
		PYRRHARCTIA. Pack.	
148	1079		Isabella—S. & A. Very common.
		PHRAGMATOBIA. Steph.	
149	1080		Rubricosa—Harr. Common.
		LEUCARCTIA. Pack.	
150	1089		Acræa—Dru. Very common.
		SPILOSOMA. Steph.	
151	1091		Virginica—Fabr. Very common.
152	1093		Vestalis—Pack. Rare.
		HYPHANTRIA. Harr.	
153	1096		Cunea—Dru. Common.
154	1096		Punctatissima—S. & A. Very Rare.
		EUCHAETES. Harr.	
155	1113		Collaris—Fitch. Common.
		HALISIDOTA. Hbn.	
156	1126		Tessellata—S. & A. Common.
157	1128		Caryæ—Harr. Rare.
158	1129		Maculata—Harr. Rare.
159	1129 (2)		*Agassizii*—Pack. Rare.

LIPARIDAE.

		ORGYIA. Ochs.	
160	1153		Difinita—Pack. Very common.
161	1154		Leucosigma—S. & A. Very common.

LIMACODIDAE.

		ADONETA. Clem.	
162	1182		Spinuloides—H. S. Rare.
		PACKARDIA. G. & R.	
163	1204		Fusca—Pack. Common.
164	1206 (1)		*Ocellata*—Grt. Very rare.

Wis. No.	Amer. No.	
		PSYCHIDAE.
		PEROPHORA. Harr.
165	1225	Melsheimerii—Harr. Rare.
		NOTODONTIDAE.
		ICHTHYURA. Hbn.
166	1227	Inclusa. Hbn. Common.
	1227 a	Palla—French.
167	1230	Inversa—Pack. Rare.
168	1232	Ornata—G. & R. Common.
		BELLURA. Walk.
169	1244	Gortynoides—Walk. Common.
		DATANA. Walk.
170	1246	Ministra—Dru. Common.
171	1254	Contracta—Walk. Common.
172	1255	Perspicua—G. & R. Rare.
		NADATA. Walk.
173	1257	Gibbosa—S. & A. Common.
174	1258	Doubledayi—Pack. Rare.
175	1259 (1)	*Vubripennis.* Very rare.
		GLUPHISIA. Bdv.
176	1264	Trilineata—Pack. Common.
177	1264 (1)	*Septentrionalis*—Walk. Common.
		NOTODONTA. Ochs.
178	1274	Stragula—Grt. Rare.
		LOPHODONTA. Pack.
179	1281	Angulosa—S. & A. Rare.
		PHEOSIA. Hbn.
180	1284	Rimosa—Pack. Rare.
		EDEMA. Walk.
181	1289	Albifrons—S. & A. Common.
		SEIRODONTA. G. & R.
182	1297	Bilineata—Pack. Common.
		OEDEMASIA. Pack.
183	1300	Eximia—Grt. Rare.
184	1301	Nitida—Pack. Rare.
185	1303	Salicis—Hy. Edw. Rare.
		SCHIZURA. Doub.
186	1307 a	Cinereofrons—Pack. Rare.
187	1310	Unicornis—S. & A. Rare.
		IANASSA. Walk.
188	1315	Lignicolor—Walk. Rare.
		HETEROCAMPA. Doub.
189	1322	Marthesia—Cram. Rare.
190	1324	Biundata—Walk. Very rare.
191	1326	Cinerea—Pack. Common.
192	1329	Manteo—Doub. Common.
193	1329 (1)	*Subalbicans*—Grt. Rare.
		CERURA. Schrank.
194	1343	Cinerea—Walk. Common.
		PLATYPTERYGIDAE.
		PLATYPTERYX. Lasp.
195	1347	Arcuata—Walk. Very rare.
		PRIONIA. Hbn.
196	1350	Bilineata—Pack. Very rare.
		DRYOPTERIS. Grt.
197	1352	Rosea—Walk. Rare.

SATURNIIDAE.

Wis. No.	Amer. No.	
		ATTACINAE.
		ATTACUS. Linn.
198	1358	Promethea—Dru. Common.
199	1361	Gloveri—Strk. Very rare.
200	1363	Cecropia—Linn. Common.
		ACTIAS. Leach.
201	1364	Luna—Linn. Rare.
202	1364 a	Dictynna—Walk. Very rare.
		TELEA. Hbn.
203	1365	Polyphemus—Cram. Common.
		SATURNIA. Schrank.
204	1366	Galbina—Clem. Rare.
205	1368	Io—Fabr. Rare.

CERATOCAMPIDAE.

		EACLES. Hbn.
206	1373	Imperialis—Dru. Very rare.
207	1373 a	Didyma—De. B. Very rare.
		CITHERONIA. Hbn.
208	1374	Regalis—Fabr. Rare.
		ANISOTA. Hbn.
209	1385	Virginiensis—Dru. Rare.
		DRYOCAMPA. Harr.
210	1386	Rubicunda—Fabr. Common.

BOMBYCIDAE.

		HEMILEUCA—Walk.
211	1389	Maia—Dru. Common.
212	1389 a	Nevadensis—Stretch. Common.
		CLISIOCAMPA. Curtis.
213	1405	Americana—Harr. Common.
214	1406	Disstria—Hbn. Common.
		TOLYPE. Hbn.
215	1409	Velleda—Stoll. Common.
216	1411	Laricis—Fitch. Common.
		GASTROPACHA. Ochs.
217	1414	Americana—Harr. Common.
218	1415	Ferruginea—Pack. Rare.

COSSIDAE.

		PRIONOXYSTUS. Grt.
219	1435	Robiniæ—Peck. Common.

HEPIALIDAE.

		HEPIALUS. Fabr.
220	1455	Gracilis—Grt. Rare.

(To be Continued.)

Notes on the Distribution of Some Trees and Shrubs in the Vicinity of Milwaukee.

By ERNEST BRUNCKEN.

The territory covered by the observations herein recorded embraces all of Milwaukee County except the two southern and the northwestern townships. Its elevation above Lake Michigan ranges from nothing to more than two hundred feet. The soil is mostly a marly clay, with more or less admixture of siliceous and calcareous sands, gravel and larger boulders.

This territory has some interesting characteristics from a phytogeographic point of view. At least one tree, the beech, here reaches its western limit, as far as this latitude is concerned. One shrub, *Cephalanthus occidentalis,* has not, to my knowledge, been reported from any station farther north in this state. But aside from such facts as these there are certain peculiarities in the distribution of trees and other woody plants in this neighborhood which make a study of it of more than local interest.

We will first consider a number of groups of trees and shrubs separately, and then append a few remarks of a more general nature.

THE BIRCHES.

There are found, within the limits above detailed, three species of the genus *Betula,* each of which presents certain peculiarities. These are *Betula papyracea, B. lutea* and *B. glandulosa.*

B. papyracea occurs exclusively on the east side of the Milwaukee river and southward along the immediate vicinity of Lake Michigan. At the same time cultivated specimens seem to thrive well in gardens in other parts of the territory. This species never grows to large size here. Where it occurs at all, it is plentiful, in a few localities even forming the dominant forest growth.

B. lutea, yellow birch, has not been heretofore recorded from this county. I have found it, however, in two places, both of which are in the Town of Wauwatosa, west of the city, and several miles from the lake shore. In neither case is it associated with the paper birch, although it is possible that it may still be found in the territory occupied by that species. The first locality is just outside of the city limits, between State and Chestnut Streets.

Here a number of old individuals stand in a northerly exposure on the slope towards the St. Paul railway tracks. There are no seedlings or young trees, but this is easily accounted for by the fact that the grove in which they stand has been deprived of the greater part of its underbrush, that the crown cover is much broken and grass has occupied the soil.

It may be stated here that these particular trees have all the typical characteristics of the species, except that the bark is very rough and does not easily roll up in clean, lateral strips. This is undoubtedly due to the great age of the individuals. I may state here that however distinct the two species of *B. lutea* and *B. lenta* may be in the east, they shade off into each other very much in Wisconsin. In the fall of 1897, in company with Prof. Filibert Roth or Cornell University, I found a grove of birches at Miller's Lake, in Langlade County, where this fact was illustrated to perfection. From trees with dark and rough bark, which should have been *B. lenta,* we gathered fruit catkins bearing scales with narrow, almost parallel lobes; from trees on which the bark was silvery, thin, and stripping off easily, we got scales with lobes spreading almost at right angles; and we even picked catkins with both forms of scales from the same trees; the same confusion prevailed with regard to the inside color and the aroma of the bark.

The second observed station of *B. lutea* is in a small wood, at the crossing of two roads in Section 31, Town of Wauwatosa. The grove is not more than three acres in extent, and apparently a remnant of the large swamp formerly extending for several miles in a northwest to southeast direction in this region. Approaching the wood from the west, it still looks like a tamarack swamp. But entering it one finds that the tamarack trees are dying or dead. The ground is strewn with the tamarack trunks and branches, and vigorous trees are seen only on the western margin, where the vicinity of the ditch along the bordering road seems to have kept the moisture conditions more favorable. Elsewhere the soil appears to be rapidly drying and losing its swampy character. No young tamaracks at all can be seen. (1) In place of the larches, hardwoods of various kind have come up, all vigorous young trees. Among these the black ash is conspicuous for its greater size and age, as if it had arrived at an earlier time, when the conditions were not yet ripe for the other species. Among these young, broad-leaved trees grow numerous specimens of the yellow-birch, all young and apparently thriving.

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1. This is the condition of practically all tamarack swamps in Milwaukee County and the adjoining territory, notably the former large swamp west of Calhoun in Waukesha County. At the latter place, the tamarack is not even spreading on the wet lands surrounding the forest.

Their average diameter is about 8 inches breast high, the largest measured by me having 11 inches diameter. There are also many small saplings and some seedlings.

The third species of birch occurring in this region is reported by Wheeler as *Betula pumila,* with a note that it occurs in Larkin's tamarack swamp, in the Town of Greenfield. I have not been able to verify this station. But in a thicket in the Menomonee Valley, at the foot of the bluff below the electric car track, I find numerous specimens of a form apparently intermediate between *B. pumila* and *B. glandulosa.* The glandular warts on the twigs are quite distinct, but the shrubs are quite tall, and the branches pubescent. They are here associated with *Alnus incana,* several kinds of willows, and some other species.

THE BEECH.

The occurrence of *Fagus atropunicea, Sudw.,* in this neighborhood presents several very interesting peculiarities. In Prof. Chamberlain's map of vegetation zones of Eastern Wisconsin (Atlas of Wisconsin Geological Survey), about two-thirds of the county is assigned to the maple group, the southwestern corner being assigned to the oak group. The northwestern third of the county, including all east of the Milwaukee River and a narrow strip on the west side of this stream, is given to the maple and beech group. This map is approximately correct as to the occurrence of beech. This tree is found in Wisconsin only in that territory lying, roughly speaking, to the northeast of a line drawn from Milwaukee in a northwesterly direction to about the east line of Dodge County, or where it strikes the western escarpment of the Niagara formation. It is characteristic of Chamberlain's maple and beech, and hardwood and conifer groups, reaching its finest development on the Kettle Range in Washington and Sheboygan Counties, where in many places it forms almost pure growths, and reaches great size. In contrast to the birches which are distinctly northern trees, the range of the beech is mostly to the south of us. In the woods of Indiana and Ohio it is becoming the dominant tree, largely because other species, which are of greater commercial value, have been removed without regard to their reproduction. It is somewhat remarkable, therefore, that the beeches of Milwaukee are of much smaller growth than those immediately northwest of us. Old trees in this vicinity rarely have a greater height than sixty feet, and a diameter of eighteen inches.

The beech is probably present in every reasonably large piece of woodland to the east of the Milwaukee River. It also extends along the immediate vicinity of Lake Michigan, at least as far south as the north line of the Town of Oak Creek, and possibly farther. West of the river its occurrence is scattered. In one timber lot there may be many, and another half a mile away may show not one. This is not likely to be due to the action of man, as there is no incentive to cull beeches from among other trees. One of the finest stands of beech is on Section 19, in the Town of Milwaukee. Here are the largest trees I have seen in this neighborhood, one of them having a diameter of 20 inches breast high, something very unusual for this locality. There are many young saplings and seedlings, and there would be more if it were not for the cattle that wander at will in these woods. The old trees are all badly rotten and attacked by fungi. A few have the lower parts so thoroughly decayed that one may look through the hollow, and the trees appear to be standing on stilts. Yet they still put forth leaves and new shoots. Other places on the west side where beeches are found are Perrigo Park, where there are a few young trees; and the same grove on State Street in the Town of Wauwatosa, where the yellow birches have been observed. On the South Side, away from the lake shore, there is a single old beech tree by the roadway on Section 35, Town of Greenfield, just above the western bank of the little lake. It stands in a thicket of aspen saplings and is dying fast.

Many years ago the peculiar distribution of the beech in Wisconsin was referred by the late I. A. Lapham to the influence of Lake Michigan on the moisture conditions. This hypothesis may be correct, but its detailed proof is still wanting. A first step in that direction must be an exact knowledge of the facts, and the above observations may be a beginning to that end.

THE POPLARS.

The two aspens, *P. tremuloides* and *P. grandidentata,* occur scatteringly all over the region. At least I have not been able to detect any special characteristics of their distribution. One finds them of all ages, from seedlings and saplings to mature trees, sixty feet high and twelve inches in diameter, which is about the largest size attained by these species in Wisconsin. They are nowhere particularly numerous.

Populus deltoides, the cottonwood, offers many interesting points. Old and large specimens of this tree are rare, except where planted by the hand of man. It is possible that this species did not occur in the region before settlement; but in the Menomonee Valley (e. g., below the electric line viaduct), there are several groups of them which may be spontaneous growth. At any rate one would look for them in localities such as this, if anywhere.

However that may be, young cottonwood trees are now quite common along the Menomonee River and in other similar situations. In addition to the neighborhood of the rivers and creeks, many seedlings and saplings are found scattered over the uplands, and even on sunbaked banks of clay. Whether these will grow into mature trees under conditions so very different from their ordinary habitat, is perhaps very doubtful. Here and there in similar localities as the cottonwood, and sometimes associated with it, seedlings and root suckers of the silver poplar, *Populus alba,* are met with, and thus that beautiful tree seems to be establishing itself away from cultivation.

In one place, and only there, as far as known, can be found the balsam poplar, *Populus balsamifera,* like the birches a distinctively northern tree. The station is on the lake shore at Fox Point, in a ravine through which a little brook finds its way from the upland down to the lake. The largest specimen I have seen there measures 20 inches in breast-high diameter. There are many young trees of various ages, and the colony seems to be prosperous.

THE WILLOWS.

W. M. Wheeler, in his "Flora of Milwaukee County," published in 1888, enumerates but three species of *Salix,* besides two cultivated varieties, remarking, however, that "there are undoubtedly several other species in the county." In a supplementary list published the following year, he adds one more, *S. lucida.* The species named by Wheeler are *S. tristis, S. longifolia, Muhl.,* and *S. myrtilloides,* and the cultivated *S. alba* and *S. viminalis.* Following is the list of species of willows found by me in that part of the county covered by this paper:

S. nigra, S. nigra falcata, S. amygdaloides, S. fluviatilis (=*S. longifolia Muhl.*), *S. discolor, S. cordata, S. Bebbiana Sarg.* (=*S. rostrata*), *S. lucida,* and *S. myrtilloides. S. tristis,* which is said by Wheeler to occur along the Kinnickinnic River, I have not found myself, but have no reason to doubt the correctness of the prior observation. There are, accordingly, ten species of willows growing wild in this neighborhood, besides several apparent local varieties or hybrids. Occasionally also a specimen of *S. alba,* which species is very commonly planted as a shade tree, is found escaped from cultivation.

There is hardly any situation in which one may not occasionally find a willow; like the cottonwood they even invade the parched clay banks. But there are three types of localities, where willows form a conspicuous and often dominant vegetation, giving character to the landscape. These types are the banks of the three larger rivers, the Milwaukee, Menomonee and Kinnickinnic, with the islands lying in them. Secondly, the numerous small water courses, and thirdly, the swampy depressions so common on the uplands, especially in the Town of Wauwatosa.

In several places along the rivers the willows form dense thickets in which the oldest and largest trees and shrubs almost invariably stand farthest away from the river bank; in some places, where the river has during recent years shifted its current, a regular gradation in the age of the willows can be noticed, from the line of comparatively old trees at the landward edge to last year's seedlings, dipping their young shoots into the water. These willow thickets, or *saliceta,* are all of recent development, to judge from the size of the composing trees and shrubs. In the case of one of them, in the Menomonee Valley, I personally recollect that twenty years ago it was but just beginning to form. The most conspicuous of these river *saliceta* are that below Helm's mill, on the Milwaukee River, and that which stretches in a somewhat interrupted line along the Menomonee from the neighborhood of the Milwaukee & St. Paul Railway shops to a little above the Monarch quarry. The latter I have studied more thoroughly than I have the others, and will treat it somewhat more fully in this place.

The thing first to attract one's attention in the Menomonee *salicetum* is the large number of species composing it. *S. nigra, amygdaloides* and *fluviatilis* are found in approximately equal numbers; *S. lucida, cordata, bebbiana* and *discolor* sparingly in comparison. But besides these well-defined types, there are so many intermediate forms, whether varieties or hybrids, that they may well drive the taxonomist to despair. *Salix fluviatilis* is most frequent on the islands, and nearest the water's edge; *nigra* and *amygdaloides* on the mainland and farther landward.(2)

Willows are not the only trees and shrubs occurring in the Menomonee Valley *saliceta.* There is an occasional dogwood,

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2. It has the appearance as if *S. fluviatilis* had a tendency to be the first on the ground, but was later crowded out by the more vigorous growth of the other species, which grow taller and overshadow the *fluviatilis.* The conditions of these islands are peculiar. They are composed of coarse gravel and shingle, coming from the calcareous rock of the neighborhood, mixed with more or less sand and fine mud. They are dry during the summer, but more or less covered with water in winter, and occasionally during freshets. The shingle allows the water falling on it to percolate almost immediately, and has hardly any power of raising water from the lower strata by capillarity. Consequently the islands, notwithstanding the river flows all around them, are of exceedingly arid character during the vegetation period of plants. This is reflected in the xerophytic character of the species which first colonize these islands. In the summer of 1899 the most conspicuous plant on these shingle flats was the wild mustard, with its very deep tap-root and rough leaves. Next in frequency was the sweet clover (*Melilotus alba*), which reduces transpiration by having comparatively few and small leaves (at least in the upper portions of the plant). I am inclined to think that the narrow leaves of *S. fluviatilis* are likewise a xerophytic adaptation. This species, wherever it occurs, tends to occupy situations in which the conditions are very similar to those of the Menomonee Valley shingle islands.

and a few young elms and cottonwoods. On the southerly side of the river, above Gettelmann's brewery, where the thicket borders on a large meadow, there is on its edge a fringe of other shrubs, containing the following species in about equal numbers: *Ptelea trifoliata* (3), *Xanthoxylum Americanun, Cornus stolonifera, Corylus Americana, Crataegus coccinea, Sambucus nigra.* These same shrubs are springing up in clumps all over the adjacent meadow, and if they are left undisturbed will probably in time convert it into a brushwood. There are a few herbaceous plants so characteristic of this *salicetum* that they deserve mention. These are *Calystegia Sepium, Lespideza repens,* and especially *Echinocystis lobata.* This species is not found anywhere, in this neighborhood, except in *saliceta,* such as those in the Menomonee Valley and at Helm's mill. But there it is very common, and with its pretty, climbing shoots, conspicuous flowers and queer fruit is a very attractive feature of the landscape, sometimes covering large shrubs almost entirely out of sight.

Cuscuta Gronovii frequently preys upon the willows. The insect enemies of the latter are very numerous, and during the later part of the season it is practically impossible to find a bough most of the leaves of which are not more less insect-eaten. Conspicuous on account of the strange effect on the branches attacked is *Cecidomyia salicis-triticoides Walsh.*

The second type of willow stations is along the banks of the small streams, many of them barely a couple of feet wide, and often dry during a portion of the summer, which are so plentiful, especially to the west and south of the city. Along these runs, particularly where they flow through meadows and pastures, individual willows, either as trees or shrubs, are met with usually at short distances, but in no such locality that I know of is there anything approaching a thicket. The species to be met with here are in their order of frequency, *S. amygdaloides, nigra, discolor, Bebbiana* and *cordata. Fluviatilis* is absent. The reason why they are confined to individuals occurring singly or in very small groups is, hardly without a doubt, that the moisture supplied by these little streams is not sufficient to affect the soil for more than a few feet along their margins, and there is consequently no room for regular *saliceta.*

A third and most interesting type is formed by the *saliceta* developed in the swamps filling depressions in the uplands, especially in the Town of Wauwatosa. These swamps are sometimes without visible outlets; sometimes they give rise to the small streams

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3. It is peculiar that this handsome shrub seems to occur nowhere in this region except in the central part of the Menomonee Valley and the adjacent slopes. In these localities it is very numerous and reproducing finely.

referred to in the preceding paragraph. Many are surrounded by woodland of greater or less density, in other cases they lie in the midst of open fields or pastures. They are all characterized by the fact that open water stands in them during the spring and early summer, but disappears almost entirely after the middle of July. The duration of the open water period depends very largely on the amount of precipitation during the summer months. The soil is a black, deep muck, sometimes peaty. As soon as the water has disappeared, it covers itself with a rank, herbaceous vegetation, in which many species of *Cyperaceae*, especially *Carex*, are prevalent, but a large number of other flowering plants are likewise found. This herbaceous vegetation covers every inch of ground not occupied by woody plants, among which the willows are often dominant.

The various localities of this kind differ somewhat in floristic detail, but the swamp found on section 34, in the large wood just west of the Soldiers' Home and north of the railway track, is perhaps the most characteristic, and has been least disturbed by human action. This swamp is surrounded by vigorous hardwood forest, very mixed in species, but with *Acer barbatum* and *Quercus alba* strongly predominating. Along the edge of the swamp are many vigorous trees of *Fraxinus sambucifolia*, together with a few young specimens of *Acer rubrum*, a rare tree in this neighborhood. About two-thirds of the surface of swamp itself is covered with shrubs. The majority of these belong to the several species of *Salix* enumerated below. Besides these, there occur *Cornus stolonifera*, *Viburnum acerifolium*, *V. opulus*, *Spiraea salicifolia*, and perhaps others. The number of shrubs of the genus *Salix* and the other species is about as three to one. Among *Salix*, again, *Salix amygdaloides* is far more frequent than any of the others.(4)

The habitus of the willows found in localities such as these is strikingly different from those along the rivers. In the willow thickets described above, the roots of the trees and shrubs can rarely be seen. In these swamps, however, stout, horizontal roots invariably lie on the surface of the soil The same peculiarity is noticeable with other trees and shrubs grown in very wet places. But still more striking is the prevailing narrowness of the leaves in *S. amygdaloides*; they often approach almost the dimensions of *S. fluviatilis*. The other species do not seem to be affected that way. It will be interesting to observe the difference in conditions

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4. In September, 1899, the leaves of S. *amygdaloides* in this swamp were almost entirely covered with some mildew, probably *Uncinula Salicis Winter*. The other species seem to be immune. But the entire thicket, from a distance, looked as if white-washed in consequence; which shows how much S. *amygdaloides* predominates.

of growing between the swamps and river margins. Both are under water at certain periods of the year. But along the rivers, this period is considerably shorter; the water covering the soil is running, and well mixed with air; the soil itself is a mixture of fine mud, sand and coarse gravel. On the other hand, in the swamps the water is shallow, stagnant and grows very warm during the spring and early summer. The soil is either a very fine muck or a mass consisting of imperfectly decomposed vegetable matter. Such soil is known to be very poorly aerated. The chief defect, therefore, of a positon in a swamp as compared with one along the river shore, seems to lie in the direction of air supply. This may account for the narrow leaves. In the absence of a sufficient supply of oxygen to the roots, the plant is compelled to reduce the vigor of its life processes. This is done by reducing the leaf area, through which these processes are carried on. Another striking peculiarity of all swamp-growing willows seems to point in the same direction. While the river willows are either trees or shrubs composed of a few stout shoots(5), the swamp willows of all species have a very large number of slender shoots, and are never trees. The advantage of this form of growth may lie in the increase of bark surface, through the lenticels of which oxygen is taken in.

There is one more station for willows in this region which deserves mention. That is the shore of Lake Michigan. As far as I am aware the two species so characteristic of places along the coast where dunes are found (*S. adenophylla* and *S. glaucophylla*) are not found within the limits covered by this article. But more or less vigorous specimens of *S. fluviatilis* are found in many places along the sandy beach. In some places also *S. nigra* is seen, but seems to be apt to take places where clay from the steep bank(6) has been washed down on the sand, especially in spots where a spring keeps the ground wet. In similar places there are also a few specimens of *S. lucida* and *S. discolor,* and I have found one *S. alba*. All willows along the lake shore are young individuals. This must be either because a change has recently occurred which gives them a chance to occupy a field from which they were formerly excluded, or because the conditions are so unfavorable that all invaders perish before they have become old and large. I am unable to say which reason is the true one.

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5. The willows aptly illustrate the difficulty of defining a tree. One of the commonest forms is one where two or three stout, ascending shoots, each several inches in diameter, rise to a height of twenty feet or more. According to the rule adopted in Sargent's *Silva*, these would have to be called shrubs; but who has the heart to refuse them the name of trees?

6. The shore of Lake Michigan in this locality is formed by a steep clay bank rising to a height of one hundred feet in some places. Between this and the water's edge there is a beech of more or less breadth, composed sometimes of coarse gravel or even boulders, but more generally of sand.

The only place where I have found *S. myrtilloides* is in the same ravine at Fox Point where the balsam poplar grows. Wheeler mentions it as occurring in Larkins' tamarack swamp.

A word should be said of the relative frequency of shrubby and tree-like forms of willows. The only species which in this region ever assume the tree form are *S. nigra* and *amygdaloides*. Except in the swamps, of which we have spoken, the tendency of these species seems to be to become trees in all cases; where we find them as shrubs, we may be reasonably sure that they are quite young. The largest willows I know of in the region (aside from *S. alba* in cultivation) are in a group of three on the road to Elm Grove, about half way between the County Poor Farm and the Waukesha line. The largest of these has an estimated height of sixty feet, the others are slightly lower. Their breast-high diameters are 23, 25 and 29 inches, respectively. Their trunks seem to be sound, and they are remarkable for the fact that they have no branches until a considerable height above the ground. Most willows divide almost immediately above the ground, if they do not come out of the root in divided shoots. Trees of a size approximating these three are very rare in this vicinity.

As to the relative numbers of the various species, *S. amygdaloides* is by far the most common; next come *S. nigra* and *fluviatilis;* the others are comparatively infrequent, although in the localities where they occur at all, they are not usually solitary.

General Remarks on Distribution.

In the map illustrating the distribution of plants in Eastern Wisconsin(7) a narrow strip of what is there called the Hardwood and Conifer Group, stretches southward along Lake Michigan to the vicinity of Port Washington. This group is characterized by the presence among the hardwood forests of the pines, hemlocks and other conifers native to this state, in more or less great numbers. The group is one with essentially northern character, as compared to the Maple and Maple and Beech Groups, lying to the southwest of it, and the regions still further southwest where the oaks predominate.

Now the fact is remarkable that quite a number of northern trees are found in limited localities in the region under discussion, such as one would be more apt to look for in the Hardwood and Conifer Group. The yellow birch has already been mentioned, so has the balsam poplar and the white birch. To these should be added the white pine, which at the time of the first settlement

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7. Atlas of Wisconsin Geological Survey.

is said to have been numerous on the east side of the Milwaukee river, and of which some individuals survived to within a few years on the river bank, about a mile above Lindwurm's. In the ravines leading from the upland to the lake beach, down the high clay banks at Whitefish Bay and Fox Point, is the only place in this region where the dwarf juniper (*Juniperus communis var. alpina*) is found, a shrub very characteristic of the lake shore farther north, and especially on the Door County peninsula. Here also the Arbor Vitae is represented by a few scattering individuals. It may be significant, perhaps, that the stag horn sumach (*Rhus hirta*) is nowhere so abundant and vigorous as in this same locality. Although this species flourishes far to the South, its greatest development is reached in the North. If the search for characteristically northern plants were extended to the herbaceous vegetation, it is very probable that many more species would be found in the region. Another peculiarity is the rarity of white oaks in the immediate vicinity of the lake. Here *Quercus rubra* is almost the only oak, while in the other parts of our district the several species of white oak are far more frequent than *Qu. rubra.* In the northern part of the state, the latter species alone occurs of all the oaks.

With the single exception of the yellow birch, all the northern plants mentioned occur only in the vicinity of the lake, some, like the juniper, only on its immediate shore. The conclusion appears therefore obvious that the influence of the lake has something to do with giving a favorable station to these species which are excluded from the surrounding country. Just how this influence is exerted, remains to be explained by exact observations. In a general way, it may be said that the local climate, so far as it affects vegetation, is modified in a two-fold manner: First, the maximum temperatures during the summer months are kept down; secondly, the amount of evaporation is reduced. Hand in hand with this remarkable occurrence of northern species on the lake shore there goes a phenomenon which makes the situation still more interesting.

The map prepared by the Biological Survey of the U. S. Agricultural Department places nearly the whole of Wisconsin within the Transition or Alleghanian life zone. But a strip along the lake shore, stretching to about the latitude of Milwaukee, is placed within the Upper Austral, or Carolinian, zone. These zones are arranged according to faunal rather than floral characteristics, but if they are approximately correctly mapped, the faunal and floral zones should very nearly coincide. We find that interesting phenomenon, therefore, that along the lake shore are mingled both Northern and Southern life forms which do not occur in this latitude farther inland. Of plants occurring in Milwaukee County, which properly belong farther south, the button bush (*Cephalanthus occidentalis*) has already been mentioned(8). Possibly the beech should be counted in this category. I have little doubt that numerous species of this kind can be found if the attention of collectors is directed to it.

It may be worth while to state in this place the law of temperature influence on distribution of life forms as formulated by the Biological Survey Division(9).

According to this formula, the northward distribution of terrestrial animals and plants is governed by the sum of positive temperatures for the entire season of growth and reproduction; the southward distribution is governed by the mean temperature of the six hottest weeks of the year. This accords exactly with the observations regarding Northern species along the lake shore; for it is precisely the heat of summer which is reduced by its influence. But it does not seem to tally so well with the occurrence of Southern forms, for the sum of temperatures during the growing period is certainly not increased by the lake influence. Perhaps modifications of the moisture relations have something to do with this. At any rate, a wide field for interesting and profitable study is here opened.

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8. This occurs, however, several miles away from the Lake shore.
9. National Geographic Magazine, Vol. VI., page 229. Merriam, Life Zones and Crop Zones, Bulletin 10, Div. Biol. Survey.

Some Remarkable Trees in the Vicinity of Milwaukee.

By ERNEST BRUNCKEN.

This part of the country is not one, at present, where one can reasonably expect to find trees remarkable for their size. The heavy forest with which most of Milwaukee county was covered but fifty years ago is not favorable to the development of great diameter in boles or wide spread of crown. On the other hand, few trees, comparatively speaking, have survived half a century of clearing and culling. Most of the trees in this vicinity, therefore, are of second growth, so-called; in other words, they are at best not much over half a century old.

Notwithstanding these facts, there are some individual trees of considerable interest on account of size, age or form. Probably the largest tree in this neighborhood is a specimen of soft maple (*Acer saccharinum*, or *A. dasycarpum*, according to the older nomenclature). It stands near the west bank of the Menomonee River, just east of the northeast corner of the Soldiers' Home grounds. This tree has a circumference of 21 feet 11 inches one foot from the ground. At this height it branches into three main divisions; the south division diverges at an angle of about 45, the north and east divisions at 55 degrees. The south division has a diameter of 36 inches at breast height. A trifle farther up it divides again, and at this point there is a strong swelling, bringing the diameter of the main stem to 47 inches. The north division has 49 inches diameter just below the point where it forks into four branches, six feet above the ground. The east division is 29 inches in diameter, breast-high, and badly rotten on the west side. There is the remnant of a former central division, 16 inches in diameter, and somewhat rotted away. The appearance of this giant suggests that its present large main divisions are stool shoots from the ruins of the main trunk, which was destroyed in youth. If this were true, it would be somewhat remarkable, as stool shoots rarely attain such great size and age. The estimated height of this tree is 70 feet. It is beginning to grow stag-headed, and is evidently past its prime.

The largest soft maple tree on record so far is one growing near Northampton, Mass. It was mentioned in Emerson's "Trees of Massachusetts" (page 489), in 1837, and then had a circumference of 12 feet 6 inches at 3½ feet from the ground. In 1889 Prof. Sargent found its circumference increased to 17 feet 4 inches. It was then hollow and much decayed. (Silva, 4, 104, n.). This tree does not divide till a considerable height, which perhaps makes its size more impressive than that of the Milwaukee tree. This mighty tree is surrounded by a number of soft maples also far above the common size. The next largest is 10 feet 7 inches in circumference, breast high, just below the fork. There is also in this group of giants an American elm of 11 feet 6 inches in circumference at 3 feet from the ground, just below where it divides into three main branches. There are no young trees in the neighborhood, a fact which is not surprising as the group stands in a meadow where the thick sward of grass makes it difficult for seedlings to sprout. If any did come up, they would soon fall victims to the haymaker or browsing cattle. The only soft maple seedling I have found in this vicinity stands on the opposite bank of the creek in the midst of the dense willow thicket. It is a vigorous youngster about four years old. There is another pretty large soft maple tree in the Menomonee Valley, near Grand Avenue, which may or may not be of spontaneous growth. Outside of these I know of no specimen of *Acer dasycarpum* growing spontaneously in the vicinity of Milwaukee at present. Undoubtedly this species was formerly common in the Menomonee Valley, but very few of the original forest trees still survive in that locality.

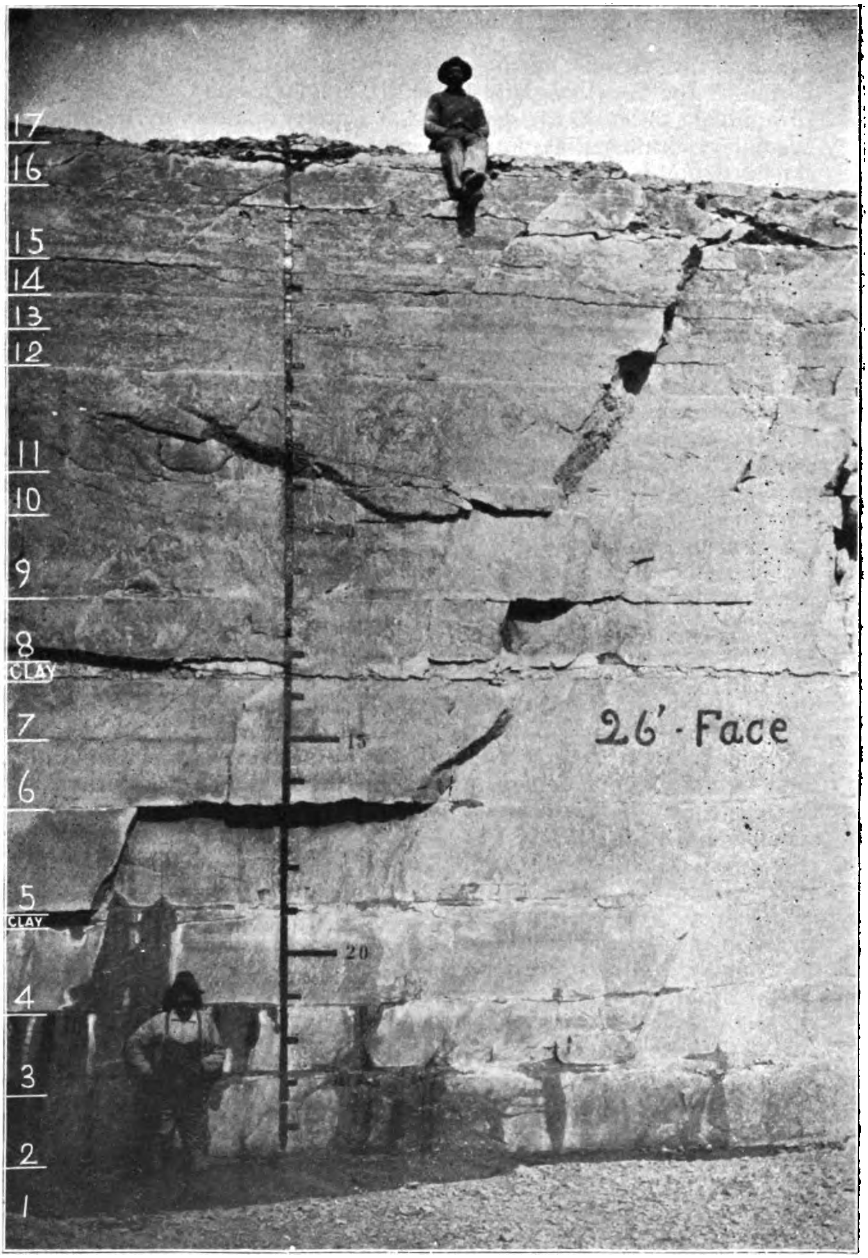
Next to the individual mentioned above, the finest elm I know of in this neighborhood, stands at the west end of a bridge over a small creek on the town line between Wauwatosa and Granville. Two main stems, diverging but very little from each other, and grown as straight as two masts, divide at two feet from the ground. At breast-height the diameters of these divisions are 26 and 28 inches. The two divisions do not branch again until a height of about sixty feet is reached, when they form one of those globular crowns, characteristic of individuals that have grown in crowded condition during youth, and have afterwards been set free.

This form of the elm is rather more common among the older elms of spontaneous growth in this vicinity, than is the vase-like form usually seen among planted trees along city streets. This is not surprising, as all our older elms during youth must have grown in close forests. Some very fine specimens of this form can be seen in the Soldiers' Home grounds. The celebrated large elms of New England mostly have a third form, in which the stem forks very close to the ground and the divisions diverge at a more or less obtuse angle, similarly to the growth of the soft maple above described. The large elm standing near the latter is exceptional in this vicinity by showing a form that looks like a modification of the New England type. It divides rather close to the ground, but the forks are decurrent at a pretty acute angle, and the secondary branches assume still more nearly vertical positions. An exception is made by a single stout branch which comes out, at a height of about ten feet from the ground, horizontally towards the west. This branch is about 6 inches in diameter, 20 feet long, and, like most horizontal branches in elms, very much of a zigzag growth. The peculiarities of form in this tree must probably be explained as follows:

The seedling grew up in a rather open position, which caused it to fork early. By the time the main divisions were ready to branch, a dense growth of shrubs, possibly willows or dogwood, had grown up around it, taking away the lateral rays of light and forcing the new shoots of the elm to grow upward, almost perpendicularly. The shrubs formed the edge of a sun-lit glade, and in one place there was a break through which the light reached the shoot from which the horizontal branch was developed by growing in the direction from which the sun's rays reached it.

Of oaks, all the large specimens I have seen belong to the tall, slender-shafted, small-crowned forest type. One specimen, however, of the swamp white oak, which grows on Barnekow Avenue, in the Town of Wauwatosa, half a mile south of the Blue Mound road, is of the type with wide-spreading crown. It is a comparatively young tree, and if it is not prematurely destroyed may develop into a very fine individual, similar to some of the great oaks of Massachusetts, described by Henry Brooks in "Typical Elms and Other Trees of Massachusetts." Last August (1899) it was about 50 feet high, with a trunk diameter of 23 inches at breast-height. The lowest branches were not more than eight feet from the ground, and the diameter of the spread of its crown was sixty-six feet as measured by pacing.

Of course there may be other large or otherwise remarkable trees in the vicinity of Milwaukee which I have never seen; and it would be well if a record of them was made by people interested in fine trees.



HAMILTON FORMATION—QUARRIES OF MILWAUKEE CEMENT CO.

The Hamilton Formation at Milwaukee, Wisconsin.

By EDGAR E. TELLER.

The geological formation displayed at the quarries of the Milwaukee Cement Company, belongs to that period known as the Hamilton, and is a part of the Devonian Age, so named by Murchison from the exposures in North and South Devon, England, for all of the strata which intervene between the upper silurian and the carboniferous rocks. The Age has been identified over a wide geographical extent of the earth's surface, being known to extend to the Continent of Europe; it is found in Russia, at the Cape of Good Hope, in China, and on the American continent, where is found the best development of the Age, as well as the most perfectly preserved organic remains; also the greatest variety both in genera and species.

The group name is that given by Vanuxem from its exposures at Hamilton, Madison County, New York. Of its organic remains he says: "It abounds in fossils, such as shells, corals, trilobites, fucoids, and a few plant remains resembling those of terrene origin. In organic remains it is the most prolific of all the New York rocks."

The late James Hall, then the geologist of the State of Wisconsin, in his report on the geological survey of the state, 1861, considers what he refers to the Upper Helderberg and the Hamilton groups, in one article. He says "we find a compact fossiliferous limestone and above it some shaly beds, likewise with fossils. These calcareous and shaly beds are clearly identified by their fossils, belonging to the age of the Upper Helderberg and Hamilton groups of New York." Referring to the organic remains he says: "The fossil remains of these beds are chiefly *Spirifer, Stropheodonta, Orthis* and *Atrypa,* a few *Lamellibranchiate* shells have been observed, a single species of *Gyroceras,* and one of *Gomphoceras.*" Inasmuch as in the preceding article he had referred what is now recognized as the Lower Helderberg Group of Wisconsin, to the western extension of the Onondaga, Salt group of New York state, it would probably be natural that he should look among the succeeding formations for the equivalent of the Upper Helderberg, and as that formation in New York is exceedingly rich in organic remains of those genera noted in Wisconsin, on a cursory examination it is probably not strange that he should have drawn the conclusions he did, and, as at the time of his investigations, the formation was considered of no special commercial importance and was therefore not worked, and as the exposure was of a slight geographical area, being known at that time only from a very limited exposure near what was then the Village of Humboldt and a short distance above it on the Milwaukee River, as well as of an exceedingly slight geological horizon, the exposure at that time being but a few feet vertically, not exceeding more than three or four feet at most, for a very short distance along the margin of the river, where they are very deeply overlaid by the drift, there was probably a reasonable excuse for the conclusions drawn. In writing of the state of preservation of the organic remains he, however, says: "The upper limestone and shales which imperfectly represent the Upper Helderberg and a part of the Hamilton groups, through nearly all of the rocks of this age there is much iron pyrites and, owing to the decomposition of this mineral, the shells are mostly destroyed, leaving only casts of the interior." While this is the case with many of the fossils collected throughout the formation, in this locality the specimens from the upper layers are quite generally in a very perfect state of preservation in most cases not only the shells, but the very fine and delicate markings peculiar to each species being perfectly preserved. In the list of fossils given in the same report described from the various formations in the state, or identified with species described from other states, only four species are given from the formation, these are simply referred to the Devonian, no reference being made to the group, and no species whatever being given as from the Helderberg.

The late I. A. Lapham in his "Report of Progress and Results" for the year 1874, made but a very slight reference to the Devonian formation, and none whatever to the group. Dr. O. M. Wright, who was the chief geologist of the State of Wisconsin during the year 1875, in his annual report for that year discussed to a considerable extent the formations that had previously been recognized as Upper Helderberg and Hamilton, and dissenting from all previous views on the subject, principally on account of the non-representation of formations that are wanting in this locality, as well as on erroneous identification of the organic remains and, as he says, chiefly on stratigraphical evidence, maintains that the formation under consideration is the water-lime group of the Lower Helderberg, of the organic remains collected near Humboldt by himself, he quotes *Orthis plicata*, now *Spirifer Vanuxami*, *Avicula rugosa*, and a species of *Tentaculites*, he also says that *Leperditia alta*, a still more important characteristic fossil, has also been found. On what he based his identifications it is difficult to say as none of the species quoted have ever been found at the locality. The *Orthis* and *Avicula* are characteristic species of the *Tentaculite* limestone of the water-lime group of New York, a formation that very clearly has no representation in this state. *Leperditia alta* is a characteristic species of the Lower Helderberg, no portion of which formation was then exposed at the locality, while *Tentaculites,* which is found in the water-lime group, is also a very common genus in the Hamilton, being fairly abundant at Humboldt in the upper layers, while in New York it forms almost a compact mass in some of the Hamilton shales.

A collection of the fossils of the locality was made by Prof. T. C. Chamberlain, then an assistant on the survey; these were submitted to Prof. R. P. Whitfield, of New York, a recognized authority on such subjects, who pronounced them to be characteristic Hamilton forms, and that no water-lime forms were contained in the collection, although, as he says, "there were among them forms characteristic of the corniferous," a formation lower than the Hamilton, yet still above the water-lime, "as well as a few forms which have their position defined as belonging to the Chemung," a still higher formation than the Hamilton. Prof. Chamberlain, geologist of the state, in his report, "Geology of Wisconsin," Vol. II., Part II., 1872, discusses very fully the Devonian Age and the Hamilton group, the only representative of the age in this state. As recognized the formation has comparatively a very limited geographical area, lying adjacent to Lake Michigan, immediately north of the city limits of Milwaukee, it has been traced for a distance of about six miles north along the lake shore, and extending about the same distance into the state, it rests in part upon the laminated shales of the Lower Helderberg, and partly upon the Niagara limestones; it has a thickness, as far as known, of about twenty-six feet, and dips slightly to the southeast. The most extensive outcrop is that at the quarries of the Milwaukee Cement Company, where it rests upon the non-fossiliferous shales of the Lower Helderberg, which latter formation has no exposures at the locality, but forms the sole of the quarries as the cement rock is removed. This locality is regarded as the typical exposure of the Hamilton group in this state, and is the locality from which has been collected all of the type specimens of fossils, except three(1), that have been described from the formation in the state. Other exposures are found in Section 11, Town of Granville, in the railway cut immediately south of the station of Brown Deer, where are exposed about three feet of the formation; this is the typical

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1. For a list of the species of the formation see The Fauna of the Devonian Formation at Milwaukee, Wis., in Journal of Geology, Vol. VII. No. 3, 1899.

locality of the fish *Rhynchodus excavatus.* In Sections 9 and 10 of the same township occurs the most northwesterly known outcrop, where it has a very slight exposure and rests upon the limestones of the Niagara formation. On the lake shore, north of the village of Whitefish Bay, and about six miles north of Milwaukee, there is a very limited exposure of the upper layers of the group. This is the typical locality of the *Cephalopod Gyroceras eryx.*(2)

In sinking the shaft and tunneling for the present water supply of the city, clays and so-called shales of the formation were encountered for the greater part of the distance, the fossils found being identical with those from the upper portion of the formation at the other localities.

Exactly how far along the lake shore, or into the state the formation may have originally extended will probably never be known, as its area has undoubtedly been greatly reduced by the eroding agencies of the drift. This is confirmed by the fossils of the group having been found at Racine, Wis., twenty-five miles south of the most southerly known exposure of the formation.

The formation as shown at its different outcrops, in its lithological character, consists of a blueish-gray or ash-colored impure dolomite, which weathers on exposure to a yellowish or buff color, due to the oxidization of the iron which constitutes one of its ingredients. Its known impurities consist of silica and alumina, and it also carries considerable magnesia. In texture it varies considerably, being quite homogeneous in some layers and quite irregular and lumpy in others, while between each of the layers there is generally a more or less well-defined layer of a semi-hard clay, being barely traceable between some layers but ranging up to about five inches in thickness between others. In degree of induration it ranges from rather soft to moderately hard, except in four of the layers, which are more or less exceedingly hard, due to the mineral matter that they contain. The minerals found are calcite, iron pyrite, zinc-blende, nickel and bitumen. The chemical composition is well illustrated by an average analysis of the layers number two to eleven, which gives:

Carbonate of lime	45.11
Carbonate of magnesia	30.89
Silica	16.61
Alumina	4.09
Oxide of iron	3.25
	99.95 (3)

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2. The third species, that of the Crinoid, Melocrinus nodosus, was described from a specimen collected from the drift. Geol. of Wis. 1861.

3. Geology of Wisconsin, Vol. 1, Page 202.

Frequent reference has been made to the shaly character of some of the upper layers. This character, while very apparent at certain points in some of the layers, cannot be considered as general throughout any layer, as but a short distance from where the shaly character is clearly observed, the layer becomes either angular or lumpy in its breakage. Neither are there in any of the layers any certain lines of cleavage, for on being broken with the hammer, they are just as liable to break across the plane of bedding as with it. Even where there has been extensive weathering, and it apparently shows a shaly character, this feature of breakage is as constant. Some of the heavy layers at times have the appearance of being made up of a number of layers, which, however, on being traced for a short distance entirely disappear and the layer becomes solid and the character lost.

The plate shown herewith is a reproduction of a photograph taken by Mr. Wm. Berthelett, one of the officers of the Cement Company. It shows a vertical face of a portion of the workings in the quarries on the west side of the river, and exhibits the first good display of joint structure that has been noted at the locality, the plate unfortunately not having range enough to show the adjoining jointure, although it shows most accurately almost the full thickness of the formation, the lower layer being partially covered by water, while a portion of the upper layer has been denuded. The numbers to the left indicate the layers referred to in this paper. The layers vary from a few inches to about three feet in thickness, the most of them being heavy in their bedding and all of them very uniform in their thickness throughout the workings. For quarry purposes they are locally known as numbers one to fourteen, beginning at the top, but as all geological formations are investigated from the lower layer upwards, for the purpose of this paper these local numbers are reversed, while three of the upper layers for palæontological reasons have been divided, adding three extra layers, making seventeen; we therefore begin with number one at the base of the formation.

Numbers one and two are rather heavy-bedded being each about 18 inches thick. They have a tendency towards being granular in their structure, are not very hard, and contain but few organic remains, those found being in the form of impressions in rather an indifferent state of preservation, and none but what have been recognized in the layers above them.

Number three is 20 inches thick; it is not as granular as numbers one and two and is considerably harder, it contains almost innumerable specimens of the genera *Stropheodonta*, and a few plant remains, few other forms being found. The *Stropheodonta* are always in the form of impressions of either the exterior or interior of single valves, and are so numerous that it may properly be called the lower *Stropheodonta* layer. The plant remains are always in a carbonized form and may be considered in a good state of preservation.

Number four is 28 inches in thickness, it is not as hard as the preceding layers, although it is more compact and not as granular; it carries casts of single valves of several genera of *Brachiopods,* and is the one layer in which the greatest number of specimens and variety of species of fish remains have been found, these being always in the form of the exterior bony plates of the teeth and are generally well preserved, although much broken up, the effect of the high explosives used in quarrying. These remains are not confined to this layer but have been found in all of the layers of the formations above, but as yet not observed below it.

Overlying number four is found a layer about three inches thick of a semi-hard clay; when first broken into it is compact and firm, but on a limited exposure it readily disintegrates, assumes rather a shaly character, and quickly becomes an impure clay. This layer contains a few organic remains of the same species as are found throughout the group, generally those of *Brachiopods.*

Number five is 28 inches in thickness, it is rather soft and has much the same character as number four; it carries only a few fossils, generally *Brachiopods,* not differing from the layers below.

Number six is 18 inches thick, not very hard, differing very little, if any, from number five, and has but few fossils.

Number seven is 18 inches in thickness and is an exact counterpart of number six in its character and organic contents.

Above number seven is found a five-inch layer of semi-hard clay, having all of the characters of that found above number four.

Number eight is 20 inches thick, a little harder than any of the layers below as more or less well defined crystals of calcite begin to appear; in its organic remains it is almost a counterpart of number three, and were it not that fossils of the genus *Stropheodonta* are fairly common in some of the upper layers it could very properly be termed the upper *Stropheodonta* layer, fossils of but few other forms are found in it.

Number nine, one of the heavy layers of the group, is 21 inches thick, slightly harder than number eight, and a little more granular. The fossils begin to assume the form of internal casts, while the variety becomes larger but still not numerous in specimens, and a few forms not observed in the lower layers begin to appear.

Number ten is about 12 inches thick; it is much harder than number nine having more calcite and iron pyrite, the fossils are more numerous in specimens with a slight increase in species.

Number eleven is the one layer in the formation that has probably the strongest characteristics; it is the heaviest-bedded layer, being 33 inches in thickness and is exceedingly hard as it contains a large quantity of calcite and pyrite, with occasionally a little zinc blende. The organic remains have been very numerous, many of them probably corals, having been absorbed and the cavities filled with the minerals mentioned. Fossils of the *Cephalopod* order prevail, large forms of *Gyroceras* and *Gomphoceras* are abundant, while of *Brachiopods* the *Spirifer, Orthothetes* and *Atrypa* are common. *Lamellibranchs* of several species make their appearance. Almost all of the above are in the form of internal casts, very few of the fossils preserve any of their external markings, while fish remains are at times to be found, being probably more numerous than in any layer above number four.

Number twelve may properly be termed the rotten layer, it is about 10 inches thick, very earthy in character and readily goes to pieces; the fossils are less numerous than in number eleven, although of the same general species, while *Orthoceras* are more numerous than in any other layer.

Numbers thirteen and fourteen are each about 10 inches thick, and while slightly different in aspect are generally about the same. They are harder than number twelve with a tendency to split up into a number of minor layers, the fossil contents are numerous; a few new forms appear, while of the large *Cephalopods, Gyroceras* and *Gomphoceras* have disappeared. Many of the fossils have their shells replaced with iron which is much oxided and therefore poorly preserved, while many others on weathering are found in a very good condition; many of the corals have been absorbed and replaced with calcite with which are at times associated a little nickel in the form of Millerite. A few impressions of plant remains are found; most of the *Gastropods* of the formation are confined to these layers, none having been noted in the lower ones, while the *Blastoids* begin and end their existence in them as far as noted.

Number fifteen has much of the characters of the two below it, is probably a little more oxided, has the same tendency of breaking into minor layers, being at times either angular or lumpy in its breakage. It also has the feature of becoming shaly but is not continuous; it is rather earthy, has less organic remains than the two layers below it, the same species being found while a few new ones appear, the most characteristic of which are the *Terebratula*.

Number sixteen is about 10 inches thick, is more compact than number fifteen, has the same tendency of minor layers and of lumpy and angular breakage, but contains not so much iron or iron oxide, while the organic remains are much more numerous. Several new forms appear among them, the *Crinoids,* which, while not numerous, being mostly confined to this layer, and *Phacops ranu,* which has been sparingly observed through the group, becoming more numerous.

Number seventeen is estimated at about 12 inches thick. It is more compact than number 16, with the same character of breaking into minor layers, some of which are more oxided than others and rather earthy. Others are very hard, due to not only the calcite they carry but also to the immense number of calcareous fossils contained therein. In some parts it is almost a compact mass of the *Brachiopods* of the group, while the disks of crinoid stems are almost innumerable, though with the exception of a small form of *Taxocrinus* almost no other species of crinoid has been found. Many corals are observed, *Phacops* becomes more common, while a species of *Proetus* is confined to it. Another portion is almost a compact mass of *Chonetes,* while *Tantaculites* is not rare. Overlaying the formation at various points are found beds of clay derived from now unknown layers that have been resolved or decomposed. These contain well-preserved specimens of all the species found in the upper layers, especially of those found in number seventeen, many of which are very abundant, the most numerous being those of *Atrypa, Cyrtina* and *Chonetes.*

While the formation may be said to have three main subdivisions, the lower being the layers numbers one to seven inclusive, which possess much the same general character; the fossils are in almost all cases in the form of impressions. The central subdivision, or the layers numbers eight to eleven, is of a distinctly different feature in all of its characters, being very much harder in structure, and the fossils in almost all cases being casts of the interior; while the upper subdivision consisting of the layers numbers twelve to seventeen and the clays overlaying them, possess many of the characters of both of the lower subdivisions. We find the fossils here in much the best state of preservation, yet there are very few species found in one subdivision but what can be found in the others. The greatest number of specimens, however, are found in the upper portion.

While the number of species found is very large for so limited an area, the total being over two hundred, the casual visitor to the locality will undoubtedly meet with much disappointment, as it is only by persistent collecting that anything like a fair representation of the fauna of the locality can be secured.

The observations presented herein have been gathered during a period of about twenty years of steady collecting at the locality, and while probably not infallible they are as the formation and its organic contents have been studied. Criticism by future writers on the subject is to be expected and is desired, as it is only by such criticism that a perfect knowledge of the formation at the locality can be secured.

The *Crinoids* and *Blastoids* of the locality have been described and figured by Mr. Stuart Weller, of the University of Chicago, while the fish remains, of which no less than sixteen species have been recognized, have been identified or described and illustrated in three separate articles by Dr. C R. Eastman, of the Cambridge Museum of Comparative Zoölogy, and who still has many of the best specimens for further study and description in future publications.

Since the publication of the list of the fauna of the locality a few new and interesting forms have been discovered.

The thanks of the writer are due to the late Thomas A. Greene, also to Mr. F. L. Horniffer and Chas. E. Monroe, local collectors, for specimens and several of the observations presented herein.

For the illustrations and descriptions of the types described from the locality, and of many of the species there found, the reader is referred to the works cited in the bibliography herewith.

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EDGAR E. TELLER.

Milwaukee, Wis., Dec. 11, 1899.

The F. S. Perkins Album of Antiquities.

A Descriptive Notice of this Important Contribution to American Archaeology.

By CHAS. H. DOERFLINGER.

The researches of the nineteenth century in anthropology, taking this term in its broad sense to include beside other branches of science the history, anatomy, physiology, psychology, education and civilization of man, have, under the leadership of foremost minds, developed as never before in the history of the human race, the comparative methods of study. Psycho-physiology, one of the youngest daughters of universal science, which is rapidly taking the place of the old-time "mental philosophy," teaches us that the development of the individual human soul as well as the individual human body takes places in the same general stage that characterized the evolution of the human race, and that our method of education, to be productive of the happiest results, must accommodate itself to the same law of nature and follow the same, the natural channels, which are the channels of least resistance.

The work to which attention is here invited, while it will be of general scientific interest, will be of especial merit as an auxiliary for comparative studies in archæology, and the accompanying text by Professor Frederick Starr, who is in charge of the Department of Anthropology of the University of Chicago, will be a valuable contribution to the branch of science it treats of.

Of the Perkins' collection of American relics, President C. K. Adams, of the University of Wisconsin, at Madison, says:

"I suppose, without doubt, this collection is the finest of its kind in the world. It is doubtful whether it can under any circumstances ever be equaled."

Dr. Geo. W. Peckham, of the Milwaukee Public Library, says:

"The Perkins album is a most important contribution to science. It is a magnificant work and full of interest for all people of intelligence. I hope that you will be able to carry it through, and I have reason to believe that you will."

Requested to say a few words about the enterprise, Professor Starr, the editor of the Album, wrote as follows:

"In some respects the Perkins 'Album of Antiquities' is unique. Among features worthy of notice are the following:

"1. It is probable that no attempt has ever been made to publish a work on prehistoric archæology in which all the specimens illustrated were reproduced in color fac-simile. Works with colored plates have indeed been published, but the illustrations could not be called fac-similes.

"2. Mr. Perkins was a trained artist of high talent. He spent a fortune in money and a quarter of a century in time in forming his archæological collection of nearly fifty thousand specimens. He devoted thirteen years of constant and conscientious work to painting, in aquarelle, representations of more than twelve hundred of the choicest specimens in this great series. These superb paintings exactly reproduce the objects themselves in size, form, markings and delicate variations in color.

"3. Mr. Perkins was an acknowledged authority upon the rare and interesting copper implements of Wisconsin and adjacent states. Probably more specimens of these were in his possession at different times than are to be found in any public museum or private collection in the world. Every specimen of this sort that he ever owned is represented in the Album."

Because of the value of this beautiful Album for comparative studies, some members of the Wisconsin Natural History Society, many years ago, proposed that the work should be published by the society. So great were the financial and other responsibilities of the publication, that the enterprise was abandoned. In 1897, however, Mr. Perkins induced Mr. Charles H. Doerflinger, who has been a member of this society for thirty-five years, and who was at one time in the book business, to undertake the publication of the work.

It is proposed that the Album shall contain one hundred and thirty-five large plates, measuring about 16 by 22 inches. These will be exact copies of Mr. Perkins' paintings and represent beautiful and typical aboriginal relics in copper, stone, bone, clay, etc. These paintings are wonderfully accurate representations. Prof. Adolph Ceuleneer, of Ghent University in Belgium, an eminent authority, made a visit to Burlington, Wisconsin, to see Mr. Perkins' collection and Album. After carefully examining both he stated that for himself and for purposes of study, he would prefer to have the Album, or a fac-simile of it, than the collection itself. Especially notable in the plates are the representations of the copper implements—several hundred in number. Practically every type of American copper implements is illustrated.

Inter-leaves of fine, strong, but thin, paper, will accompany the plates. They will bear the field notes of Mr. Perkins regarding the specimens represented on the accompanying plates and such additional matter, by the editor, as may seem necessary to a full understanding of the illustrations.

There will be a text of at least one hundred pages. In this text will be presented a sketch of the archæological work so far done in Wisconsin—a state fortunate in having had in its population such workers as Increase Allen Lapham and Frederick Stanton Perkins—a study of the relation of the archæology of the state to that of the United States at large, comparison of American and European prehistoric archæology and a critical study of the Perkins collection.

An elegant and substantial all-leather cover for binding will be supplied with each copy of the work. The Album will be issued in twenty-seven parts. These parts will average five plates with inter-leaves. The text and binding-cover will accompany the final part.

The parts are to appear at monthly intervals. They will cost ten dollars each and will be sent by express C. O. D. Thus the cost, *to subscribers,* will be two hundred and seventy dollars. Upon completion of the work the price will be raised to four hundred dollars. The "Walter's Album of Keramics," containing one hundred and sixteen plates, is sold at five hundred dollars a copy; the Perkins Album of equal beauty, execution and interest, costs but two hundred and seventy!

Part I will soon be placed in the hands of the artists. The following parts will not be issued until the number of subscriptions warrants publication. Four hundred subscriptions will be necessary to cover the first cost of the work, which four hundred copies will amount to, at least, one hundred thousand dollars. It is hoped that there will be no interruption of the work after the second part appears, because the 1,200 water color paintings are all ready.

The work is to be dedicated to Dr. Increase Allen Lapham, long an honorary member of this society, and known throughout the world by his momumental work, "*The Antiquities of Wisconsin.*" His influence upon the advancement of science and education needs, here, no comment. He was director of the first geological survey of this state and was the successful instigator of the establishment of the United States Signal Service, with its system of Daily Weather Reports. In this dedication the work itself is honored. The Lapham family heartily approve the plan of publishing the Album, and of the dedication, and have supplied some unpublished drawings and maps, made by Dr. Lapham in his last years, which will be printed in the work.

The Museum of the Wisconsin Natural History Society, founded in 1857 and donated to the City of Milwaukee in 1882, contained some of the first copper implements, recognized as such by Prof. Peter Engelmann, Mr. Perkins and Dr. Lapham. The idea of publishing the Perkins Album originated in the society and, in promoting its appearance by this notice, it performs a labor of parental love.

NATURAL HISTORY NOTES.

On the Occurrence of the Mocking Bird in Milwaukee County.

The northern limit of the range of the mocking bird *Mimus polyglottus,* is stated to be the forty-second parallel of latitude, which is approximately that of Chicago. The following is offered as evidence that this limit should be extended at least one degree or to the latitude of Milwaukee.

In McIllwraith's "Birds of Ontario," is recorded a well-authenticated case of a pair of these birds nesting one year near the city of Hamilton, Ontario, which is in latitude 43 deg. 15 min. As Hamilton is at the extreme north of an arm of the Carolinian Faunal area—as outlined by the United States Biological Survey in 1897—that extends into Canada, and as Milwaukee is near the north end of a similar arm that enters Wisconsin, we might expect to hear occasional reports of their presence near the latter city.

That the mocking bird was at one time not uncommon in this locality would appear probable from the following extract from a paper published by this society in 1885, and written by the late Dr. P. R. Hoy, of Racine—a city twenty miles south of Milwaukee. He writes: "Mocking birds nested freely in the near vicinity of Racine previous to 1856. I obtained three nests and knew of several that I would not molest and of three others broken up by boys. This matchless songster was continually heard among the thorn thickets and witch-hazel bushes. The ax and plow have destroyed the haunts of this interesting bird; none have been seen for fifteen or twenty years."

During the past five years, however, the following instances of their occurrence in Milwaukee County have come to our notice:

On the evening of June 29th, 1894, we found a bird of this species in full song in a tree on the banks of Oak Creek, about half a mile from its outlet. As we had but lately come from a two years' sojourn in the Gulf states, where we had frequent opportunity to become acquainted with the mocking bird, it is not likely that a mistake was made in identification.

Mr. John W. Dunlop has also reported the fact of a pair nesting near the same locality a few years ago.

Mr. Robert O. Wanvig, a member of this society, has a mocking bird's nest and eggs in his collection, which he found in 1897 in a thicket just west of the city. The locality is a small sheltered grove, abundant in underbrush, the owner of which prevents all trespassing on the property, and for several years past Mr. Wanvig has found several of the birds frequenting the spot each summer, and has been in the habit of visiting the place evenings and at night to hear their song.

Thus it would seem that there are a few secluded spots in the vicinity of Milwaukee which the mocking bird visits regularly each year, and there raises its young. Possibly a few may pass on to still more northern points in Wisconsin, but if so it has not, as far as we can learn, been as yet reported.

Is it not then highly probable that Milwaukee is the most northern point in the United States visited regularly by the mocking bird? W. J. BENNETTS.

Bird Tragedies.

The death of every wild creature is a tragic one, asserts Earnest Seaton Thompson, and probably few of our birds live out the possible span of of their existence. Disease and old age are seldom permitted to run their usual course, for soon after the resulting feebleness or lack of vigilance manifests itself, the watchful hawk, owl, or fox, interferes, and the end is still a tragedy. Storms and scarcity of food, the accidents of migration, birds and beasts of prey, and man, are some of the agencies of bird destruction.

Two cases have been brought to our attention recently that are somewhat removed from the common. Mr. F. Kerchner, a member of the Wisconsin Natural History Society, has described to us the finding of the body of a golden-crowned kinglet, *Regulus satrapa,* in a cluster of burrs in a plant of the common burdock, *Arctium minus Schk.* Late in the fall the heads or burrs of this plant may be found bunched or tangled together near the extremities of the branches, and against one of these the kinglet had evidently involuntarily flown, only to be seized by the minute hooks with which the burrs are provided; its subsequent struggles to escape only entangling it more securely.

Had this occurred to a larger bird, the latter would doubtless have escaped, carrying a number of the burrs with it and thus have been the agent of that method of seed dispersion which *Arctium minus* has so successfully evolved.

The second instance illustrates how a habit or instinct misdirected frequently ends disastrously. Mr. Geo. G. Phillips also a member of the Wisconsin Natural History Society relates that for several days in December last he observed a downy woodpecker, *Picus pubescens,* busily engaged enlarging a small hole in the side of a stable on his premises. Finally the hole appeared to be completed and a few days afterwards, upon entering the stable in the morning he observed a bird fluttering feebly on the floor. It was easily captured and upon being set down again put its head beneath its wing and appeared to sleep, but when Mr. Phillips returned shortly after with some food, it had fallen over and was dead. Evidently it had entered the building through the hole it had made and being unable to find any exit had perished for lack of suitable food and from the extreme cold that prevailed at the time.

In the woods in winter time may easily be found numerous dead trees and stumps containing freshly made woodpecker holes that go inwards for a few inches and then downwards for eight inches or a foot. These, at least many of them, are the work of the downy woodpecker, and are probably used as sleeping places and as a retreat during storms.

The particular bird mentioned had perhaps thought it had discovered a tree or stub of unusual dimensions, and its error had resulted in the way described. W. J. BENNETTS.

The Wild Animal Life of a Large City.

Even in our crowded city, a few of our native wild animals manage to exist and to hold their own. The cotton tail rabbit, *Lepus sylvaticus,* is present among us in greater numbers than is generally supposed. In our parks they may be seen on moonlight nights; and after a fall of snow their tracks are easily to be found in many quarters of the city. The lumber yards and certain willow thickets near our rivers are their favorite haunts, but even in the resident quarter of the city they are not absent. On the East Side we have happened upon one during a dense fog one Sunday morning in early winter, and shortly afterwards found one that had been freshly killed by a Northwestern train near the North Avenue crossing.

A red fox, *Vulpes vulgaris,* was captured in October of this year in a chicken pen at Wells and Twenty-fifth Streets, which is a thickly peopled district; and as poultry owners in that locality had been suffering losses for a month or more, Reynard had no doubt been at large in that district during all that time.

A mink, *Putorius vison,* was lately captured behind a refrigerator in a saloon on Ninth Street, having been discovered there by a dog that entered the saloon along with a customer.

W. J. BENNETTS.

Swarming of the Milkweed Butterfly, Danais Archippus.

During the summer months—June, July and August—these butterflies are present in large numbers, though I have never seen them flying in companies of more than two or three. During the early part of September, however, I have noticed for the past six or seven years that they gathered in large migratory swarms. The motive of these migrations, I believe, is the impossibility of finding food and to avoid the cold of the winter months. The insects are naturally forced to seek milder climes and localities where plant life is more abundant. The question arises in my mind, however, what then might induce these insects to subject themselves to the dangers and trials of a northward journey in the spring of the year. The milkweeds are well represented in the south and plant life in general is more abundant than in our latitude, so that we cannot attribute their northward migration to be due to the lack of food or to cold. I believe that these annual migrations can be likened to those of birds of passage, and that the same instinct which governs these birds in their migration is also the cause of the same habit in *Danais archippus.*

In September 9 to 11, 1898, I noticed small swarms of *D. A.* in different places in the city, containing some forty or fifty individuals, some flying, others busily engaged in sipping the horse brine in the street; this they seemed particularly to relish. It is interesting to note how closely the given dates correspond with the following: From Aug. 29 to Sept. 6, 1899, their gatherings came to my notice in various parts of the city. A daily increase in their numbers was noticeable, particularly so at Lake Park, which it appeared was chosen as their place of rendezvous. Toward Sept. 6, I was unable to note any of the smaller swarms throughout the city, but found immense swarms at Lake Park, where they were present in thousands. The females outnumbered the males considerably. Several pairs were found in copulation. A strange fact which came to my notice was that these insects would sit very closely together, one upon each adjoining leaf, and thus several branches on one tree were covered with them, while the rest of the tree would be deserted.

In these gatherings I found that the butterflies preferred elm trees to any other for resting purposes. It is true I noticed a few on oak, maple and basswood trees. The reason that the elm trees received the preference is due, in my opinion, to the fact that its leaves offer the insect a firmer hold than do the leaves of the other trees. The elm leaf at this time of the year turns slightly up at the edges, thus giving the butterflies an opportunity to clasp the edges of the leaf, while in the leaves of the bass, oak and maple they are compelled to hold to the flat surface. In resting, these insects always chose the upper side of the leaf, and sit with their heads pointing towards the trunk of the tree or upwards, i. e., in a direction opposite to the growth of the branch. I am unable to state whether the migratory flights are undertaken during the night or day, never having been fortunate enough to be an eye-witness. Mr. F. Rauterberg has informed me that he at one time saw a flock of these butterflies start, from the same locality where my notes were made, and choose a southeasterly course across Lake Michigan. This was at dusk, so we may feel positive that that flock migrated under the cover of night; other observers too have noted nocturnal flights of these insects.

P. H. DERNEHL.

On the Occurrence of the Hawk Moth Argeus Labruscae in Wisconsin.

Although at home in Japan this insect has found its way to the United States, either by means of transportation, or possibly employing its extremely enduring powers of flight, it has managed to find its way hither unassisted. It is occasionally met with in the more southerly regions of the United States. In Wisconsin it is very rarely seen. I can enumerate but two specimens captured in this state. One was taken in Sheboygan in 1893 and is now in the possession of Mr. F. Rauterberg.

The writer was fortunate in capturing a second individual Sept. 5th, 1899. When taken it was very intent upon visiting the blossoms of various species of gourds, seemingly prefering these to all other flowers, of which there was a great variety in the same garden. It was 7:30 P. M. when captured and quite dark.

P. H. DERNEHL.

Depredations of the Cottony Maple Scale.

The cottony maple scale, *Pulvinaria innumerabilis, Rathv.*, whose annual presence by reason of its comparatively small numbers has gone almost unnoticed for several seasons past, made its appearance in late May and early June of this year, despite the severely cold weather of the past winter, in such unusually large numbers on our shade and ornamental trees, as to cause serious apprehension among property holders.

At about the same time it also appeared in destructive numbers in Chicago, Evanston, Lake Forest, Waukegan and nearly all of the lake shore towns between Milwaukee and Chicago.

In and about the City of Milwaukee are many small nurseries from which large numbers of young maples are annually sold and shipped to the neighboring villages and towns and there again transplanted.

Several such nurseries examined this fall have the small limbs quite covered with the minute and inconspicuous brown overwintering scales. This may in some measure account for their unusually large numbers and wide distribution during the past year in this territory. As usual the soft maples suffered most severely from this attack, but many specimens were also observed on hard maple, box elder and ash, while others were taken on elm trees, the grape vine and currant bushes. The limbs of some small maples on Chestnut Street, between Thirteenth and Fourteenth streets, were so badly infested as to give them the appearance of having been sprinkled with whitewash. One such small limb showed forty-one of these destructive egg-laden insects reposing on its surface, within a compass of six inches.

When noticed these trees had already lost much of their foliage and later observations proved that several of them had been killed outright.

As a general thing, however, these attacks only weakened the vitality of the trees, making way for tree diseases and the ravages of the Tussock moth caterpillar, *Orgyia leucostigma Sm. and Abb.*, and like insects, which followed soon after.

A thorough canvass of the city by the entomological members of the society, showed the most badly-infested portion to be a district on the West Side, bounded by Tenth Street on the east, Twentieth Street on the west, Grand Avenue on the south and Chestnut Street on the north, a tract ten by five blocks square.

Thousands of the young scales appeared upon the leaves in early August, but at least 50 per cent. of these had the appearance of being badly parasitized.

By early October the most of the healthy scales had transferred themselves to the limbs where they now repose in considerable numbers. We have counted as many as 200 upon a single small branch, fifteen inches long and less than one-eighth inch in diameter. Some of these healthy scales lingered upon the leaves until their falling (as late as November 1st).

When this insect pest appeared the attention of our citizens was called to its destructive methods by this society. Through the kindly medium of the newspapers remedies were recommended, the employment of which by many of our property holders, together with the prevalence of its natural enemies, will, we trust, do much toward holding the insect in check in the coming year.

C. E. BROWN.

Fruit Feeding Habit of the Cotton Worm Moth.

The cotton worm moth *Aletia argillacea, Huebn.,* widely known in the southern states by reason of its destructive habits, has been repeatedly observed for several seasons past, in quite large numbers, puncturing ripened grapes in early October, in small vineyards in and about Milwaukee, Wis.

Often as many as five or six of these moths were observed at night feeding upon a single bunch, and often nearly every second bunch was thus beset with insect depredators, the damage to the yield (in bruised fruit) being anything but slight.

At such times the insects did not appear to mind the light of a dark lantern and were quite approachable, enabling one to tumble them into a cyanide jar with ease.

After settling upon and piercing a grape they would generally remain in that position for several minutes and then fly away or shift to a neighboring grape.

The fruit-feeding habit of the adult moth is well known, and is especially marked in the south; the curious arming of the hanstellum enabling it to pierce fruit easily. Dr. L. O. Howard, entomologist of the United States Agricultural Department, says that he is not aware that this habit of the moth has ever been observed before as far north as Milwaukee, Wis.

C. E. BROWN.

The Balsam Apple Vine as an Insect Trap.

A rather unusual occurrence which created some little interest among local entomologists and others in August of the present year was the ensnaring of a large green dragon fly *Anax junius, Drury,* by a tendril of wild balsam apple, *Micrampeles lobata, Green.*

It is conjectured that the insect had settled upon the vine and becoming somewhat benumbed by the cool of evening, was easily entrapped by the outreaching tendril, which had wound itself quite tightly, twice about the insect's body, near the joint of the seventh and eighth abdominal regments.

The prisoner remained quite lively for several days, often flying out to the length of its vegetable rope, until it finally perished at the hands of a careless observer.

After our attention had been drawn to this curiosity, several instances of the entrapping of smaller species of the order *Odonata* by vine tendrils were also noted. In these cases the insects had been made prisoner by the tendrils entwining itself about their limbs.

C. E. BROWN.

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BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY

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PLACE OF MEETING.

LECTURE ROOM, Third Floor of Milwaukee Public Museum.

[The Bulletin of the Wisconsin Natural History Society is published quarterly and distributed by the Milwaukee Public Museum, an exchange with other publishing societies and institutions is solicited.]

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BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 1, New Series. **APRIL, 1900.** **No. 2.**

Proceedings of the Wisconsin Natural History Society.

November 24, 1899 to January 25, 1900.

THURSDAY, NOVEMBER 24, 1899.

This meeting was devoted to an illustrated lecture by W. H. Dudley, of Platteville Normal School, on the colors of flowers. Fifty-four persons were present. After the meeting the board of directors elected the following to membership: Messrs. E. C. Case and Henry G. Ruenzel, and Dr. Chas. D. Stanhope.

THURSDAY, DECEMBER 28, 1899.

Held in the museum lecture room with President Peckham in the chair and twenty-six persons present.

After the minutes of the previous two meetings had been read by the secretary, Director Bruncken of the section of botany reported that prices had been obtained upon the cards and printing for the proposed plant census of Milwaukee County, and that the expenditure would not exceed ten dollars.

A list of those publications of the society that are represented in the library of the public museum was handed in by P. H. Dernehl. These publications consist of (1) annual reports for the years 1870 to 1889, inclusive—those up to 1880 being published in German; (2) six numbers of "Occasional Papers;" (3) seven numbers of separate lectures; twenty-eight publications in all. Of these, several are represented by only one copy, while of the others there are from two copies to five hundred remaining.

The president informed the meeting that the first quarterly bulletin of the society was then in the hands of the printer and that the manner of its distribution remained to be decided upon.

The museum board had agreed to attend to the distributing, and to pay the postage, but required a list of the societies and institutions to which it should be sent. The recording secretary was then instructed to prepare a mailing list for that purpose.

Chas. E. Brown pointed out that the want of a blackboard was frequently felt at the meetings, and a motion was made by Dr. Dorner that the corresponding secretary communicate with the museum board in regard to supplying the lecture room with a wall blackboard at the east end. The motion was seconded and carried.

Dr. S. Graenicher then read a paper of much interest, entitled, "Our early wild flowers and their insect visitors." *Trillium nivale, Erigenia bulbosa* and *Salix discolor,* which blossom in this vicinity in the order named, were the plants chiefly considered. *Trillium nivale* he had found in bloom as early as March 26th, but had never observed any insects visiting it, and had concluded that like the majority of the Trilliads, it was self-fertilized. Upon *Erigenia bulbosa* he had taken ten species of insects and upon *Salex discolor* eighty-four. The paper was illustrated by specimens of the plants and insects mentioned and a considerable portion of the paper was devoted to a consideration of the relation of the insects to one another and to the plants visited.

It was announced that at the next monthly meeting Dr. H. Dorner would read a paper upon the giant cuttlefish, of which the museum possesses a papier-maché cast.

THURSDAY, JANUARY 25, 1900.

Held in the museum lecture room. President Peckham occupied the chair and sixty persons were present.

After the usual opening business had been transacted, Mr. George Shrosbree, taxidermist of the Milwaukee Public Museum, read an instructive and practical paper, entitled, "Modern Taxidermy."

Mr. Shrosbree contrasted the present methods of the art with the old-time methods of *stuffing* specimens, and gave credit to the South Kensington Museum, London, and to the American Museum, New York, for inaugurating the change. A successful taxidermist, it was stated, should primarily be endowed with a love of nature and with a good perception of form and color. He should be a constant student and accurate observer of the habits and haunts of animals, should have a knowledge of their myology and osteology in as far as it affects their surface and outline, and should have considerable artistic skill in modelling and coloring. He should also be familiar with the use of the principal tools employed in the different artisan trades.

The applications of taxidermy intended for the instruction and entertainment of the public were considered. Among those mentioned were the making of elaborate *groups* of animals in which their natural surroundings were accurately reproduced, of *sets* illustrating the life histories of birds or other creatures and of series of familiar animals, such as dogs, domestic fowls or pigeons.

The methods of preparing skins for the purpose of the student and scientist were described, and the care of museum specimens discussed.

Thorough poisoning, daylight, and frequent handling will prevent insect depredation. For specimens, however, that had become infected, Mr. Shrosbree had found that spraying with turpentine and then placing the specimens in an air-tight box for twenty-four hours was most efficacious in destroying the larvae of *Dermestes,* while for moths and *Dermestes* in the beetle form he recommended naphtha.

Dr. H. Dorner followed with an exceedingly interesting and lengthy paper on "The Giant Squid and its Allies." The structure of this largest and least known of the members of the Cephalopod family was described in detail and illustrated by charts picturing in colors the form and anatomy of the creature. The habits of other members of the squid or decapod group were described, and then Dr. Dorner gave the results of his observations upon members of the octopod or cuttlefish group, whose habits he had had many opportunities of studying, during four years' connection with the Hamburg museum. The color changes of these animals were described and had been found to depend upon the temperature of the water and the animal's vitality. The holding power of the suckers on the arms of the cuttlefish he had found to be comparatively weak, at least while it was in captivity. A criticism of Victor Hugo's description of the devilfish, and remarks on the utility of these creatures and the part played by them in nature closed the paper.

At this meeting Mr. Hugo Lutz and Mr. Herman Pereles were made ordinary members of the society, and Mr. F. M. Benedict, of Waupaca, a corresponding member.

W. J. BENNETTS, Secretary.

The Fertilization and Insect Visitors of our Earliest Entomophilous Flowers.

By Dr. S. GRAENICHER.

Among the first plants appearing in our neighborhood in early spring, only those species will receive our attention whose flowers rely more or less on the co-operation of insects to secure fertilization, and which for this reason are called entomophilous flowers. The few species of anemophilous or wind-pollinated plants, blooming at the same time of the year, as for example our species of *Alnus* (alder) and *Corylus* (hazelnut), will, therefore, not come within the reach of these considerations.

In a small piece of open woods along the banks of the Menomonee River and opposite the grounds of the County Insane Asylum, two small plants may be observed together, one of them—*Trillium nivale,* Riddell (dwarf white trillium)—opening its flowers two or three days in advance of the other—*Erigenia bulbosa,* Nutt, whose popular name, harbinger-of-spring, has been selected in accordance with its early arrival. Under extremely favorable circumstances, the first flowers of both species may be expected towards the end of March. The spring of 1898 was remarkable in this respect, as it presented us with the first flowers of *Trillium nivale* on March 26th, and with those of *Erigenia bulbosa* on March 29th. When spring puts in a late appearance, however, the opening of these flowers may be delayed as late as the second week in April. This was the case last year (1899), when the first flowers of *Trillium nivale* were not observed previous to the 11th of April and those of *Erigenia bulbosa* on April 12th.

Both plants occupy the same position in the soil, and bloom synchronously. The families to which they belong, produce, as a rule, entomophilous species, and for this reason the question arises, whether these two species enter into competition with each other for the visits of any of the anthophilous (flower visiting) insects, flying at this early period.

The plant of *Trillium nivale,* Riddell, a member of the Lily family *(Liliaceae),* usually attains a height of 5 cm. and bears, as is characteristic of the genus *Trillium,* a single terminal flower, arising from a whorl of three leaves. The flower of our species holds an erect position on a pedicel of 8 mm. length, and has a corolla of three white, recurving petals, giving the flower a diameter of 15 mm. There are two rows of stamens surrounding the pistil, the three anthers of the outer row being longer than those of the inner row, and shedding their pollen in advance of the latter. The stigmas of the three slender styles are situated about 3 mm. above the long anthers of the outer row, and become receptive at the same time that the anthers of the inner row begin to empty their pollen.

During the last three years I have repeatedly watched the flowers of *Trillium nivale* in favorable weather, and have never seen a single insect visit them, or even take the slightest notice of them, although insect visitors were not lacking on the flowers of *Erigenia bulbosa,* near at hand. There is nothing astonishing about this, as the flowers of *Trillium nivale* have no fragrance, are devoid of nectar, and offer nothing but pollen to attract insects; besides, it is a noteworthy fact, that our other species of *Trillium,* appearing later in the season, seem to have very little attraction for insect visitors and that even the large, conspicuous flowers of *Trillium grandiflorum,* Salisb. (wake-robin), with their fair supply of nectar, receive comparatively few visits in our neighborhood.

From the foregoing we must conclude that *Trillium nivale* is not visited by insects, and is, therefore, not cross-fertilized. In view of the erect position of the flower, and the elevated situation of the stigmas, there is no possibility of self-fertilization being effected through the falling of pollen on the stigmas. The only way open to spontaneous self-fertilization under these circumstances, is by the recurving of the style to such an extent as to bring the stigmatic surface in contact with pollen of a dehiscent anther. This is in fact the course adopted by the flower to insure self-fertilization, and is, so far as I have been able to observe, the only method of fertilization adopted at all.

According to Gray's Manual of Botany, the range of *Trillium nivale* is from western Pennsylvania and Kentucky to Minnesota and Iowa; whether this plant resorts to the same mode of pollination exclusively in other parts of the country, as it does in our locality, can not be stated, as up to the present time no account of the fertilization of this species has been published.

With *Erigenia bulbosa* Nutt, the case is altogether different. In 1882, A. F. Foerste (1) gave an account of the floral structure of this small, umbelliferous plant, and called attention to the proterogyny of the flowers, in other words, he made known the fact that the stigmas are receptive before the anthers of the same flower discharge their pollen. This announcement was received with much surprise among biologists, as up to that time, the Umbelliferae (Parsley family) had been regarded as a family producing without exception species with proterandrous flowers, flowers emptying their supply of pollen before the corresponding stigmas become receptive.

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(1) A. F. Foerste. Dichogamy of Umbelliferae. Bot. Gazette, Vol. VII (1882), pp. 70–71.

In 1888, Chas. Robertson (2) published a paper on "Proterogynous Umbelliferae," in which he confirmed Foerste's views on *Erigenia bulbosa* and added the four following species of this country to the list of proterogynous Umbelliferae: *Sanicula marylandica,* L., *Zizia aurea,* Koch., *Pimpinella integerrima,* Benth. & Hook. and *Polytaenia Nuttallii,* D. C. In 1891, Kirchner (3) discovered in the vicinity of Venice, in Italy, a proterogynous species (*Echinophora spinosa,* L.) among the European Umbelliferae. From all this it is evident that to *Erigenia bulbosa* belongs the distinction of being the first umbelliferous plant in which proterogyny was recognized and reported.

In the locality where my observations have been made, the plants of *Erigenia bulbosa* rise 12 to 18 cm. above the ground and grow together in small patches. In the first or female stage, the two styles bearing the receptive stigmas at their summit protrude from the little white, purplish-tinged flower, but none of the anthers are shedding pollen. The five erect petals enclose the stamens, and the latter are incurved in such a manner as to partly conceal the nectar-glands from view and afford them protection. Nectar is secreted in abundance on the greenish disc on top of the ovary. Later on the petals and also the styles become divergent, the stamens assume an erect position, and one by one the anthers burst open and expose their pollen; in this way the flower enters into the second or male stage.

Pollination takes place in the female stage, when an insect, arriving from another flower in the more advanced male stage, and having grains of pollen attached to different parts of its body, comes in contact with the receptive stigmas. In *Erigenia bulbosa* we have a well marked case of proterogyny, the stigmas being receptive long before the anthers of the same flower dehisce, and such a contrivance generally results in securing cross-fertilization, and, on the other hand, in preventing self-fertilization.

Although the flowers of our first representative of the Umbelliferae appear so early in spring that very few insects might be expected to render their services as cross-fertilizers, yet observation shows that even in our surroundings, with prevailing cool weather at that time of the year, the flowers are visited sufficiently to obtain favorable results. Under adverse circumstances, the insects may not appear at all for a whole day, or even for a few days in succession. But an hour of sunshine and calm weather is generally all that is needed to arouse individuals of the more hardy species from their lethargy and bring them to the flowers.

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(2) C. Robertson. Proterogynous Umbelliferae. Bot Gazette. Vol. XIII (1888) p. 193.

(3) O. Kirchner. Die Blueten der Umbelliferen. Jahresh. d. Ver. f. Vaterland. Naturk. in Wuerttemberg, 1892, pp. 89-91.

Within the first two weeks of the blooming period of *Erigenia bulbosa,* that is, within the time usually elapsing between the appearance of the first flowers of this plant and those of our earliest willow—*Salix discolor* Muhl., I have taken the following ten species of insects, visiting the flowers of *Erigenia bulbosa:*

A. Hymenoptera.

Bees—Apidae: (1) *Apis mellifica,* L. ☿ ; Andrenidae: (2) *Halictus similis,* Sm. ♀ ; (3) *Halictus confusus,* Sm. ♀ —all sucking.

B. Diptera (Flies).

Tachinidae: (4) *Gonia capitata, De G.;* (5) *Siphona geniculata, De G.:* Muscidae: (6) *Lucilia caesar,* L.; (7) *Lucilia cornicina, Fabr.;* (8) *Pollenia rudis, Fabr.;* Scatomyzidae: (9) *Scatophaga squalida, Meig.;* Sapromyzidae: (10) *Lonchaea polita, Say*—all sucking or feeding on pollen.

Of these, the three bees, and among the flies the two species belonging to the family of the Tachinidae are anthophilous (flower-loving) insects in the strict sense of the term, as they depend on floral diet for their own subsistence, and, so far as the bees are concerned, for the subsistence of their offspring besides. The five remaining visitors are flies, living, as a rule, on decomposing organic matter, and visiting flowers occasionally to feed on nectar and pollen. The flies belonging to this latter group are the first to appear on the flowers; they are hardy species, very able to withstand the effects of cold weather, and may be observed towards spring on sunny days and in sheltered spots long before the umbels of *Erigenia* make their appearance above the dry leaves. This is especially true of the dungfly *(Scatophaga squalida, Mg.)* and the two species of *Lucilia,* well known under the popular name blue-bottle flies. Speaking of *Pollenia rudis,* Fabr., Williston (4) remarks, that numbers of these flies may be observed on mild days of winter, crawling over the snow. In the locality where the visitors of *Erigenia bulbosa* were taken, numerous specimens of the different species referred to above were noticed a few days ahead of the first flowers of *Erigenia,* eagerly sucking the sap escaping from the injured stems of maples. From these facts it is evident that the very first flowers of *Erigenia* have an opportunity of being thoroughly and successfully visited, and in addition to this we see that the first visitors are flies, which do not depend on floral diet exclusively and are not to be regarded as anthophilous insects.

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(4) S. W. Williston. Manual of N. Am. Diptera, 2d Edition, p. 141.

The two remaining species of Diptera (*Gonia capitata,* De G. and *Siphona geniculata,* De G.) belong to the Tachinidae, a family well known from the fact that the larvae of all of the species live parasitically on other insects, while the adult flies generally obtain their food from flowers.

After the blooming period of *Erigenia* has fairly begun, the bees appear among the other visitors. The honey bee is frequently observed on the flowers, and the remaining two bees on the list are species of *Halictus,* a very important genus belonging to the Andrenidae, a family comprising all of our short-tongued or less specialized bees.

In Southern Illinois, where *Erigenia bulbosa* seems to be more abundant, and where, on the first warm days of spring, the climatic conditions seem to bring out a more numerous set of visiting insects than in our vicinity, Robertson (5) has taken a larger percentage of bees on this species, than on any of the other species of Umbelliferae observed by him.

By reviewing the results obtained, we are led to the conclusion that *Trillium nivale,* Riddell, and *Erigenia bulbosa,* Nutt. do not interfere with each other as regards their mode of pollination, *Trillium nivale* not relying on the visits of insects, but resorting to spontaneous self-pollination, *Erigenia bulbosa* on the contrary furnishing a well-defined case of proterogyny and securing cross-pollination through insect agency.

The small size of both plants is remarkable, when compared with that of near related forms. The position of the flowers in close proximity to the ground and among fallen leaves and dry grass, undoubtedly affords protection from the ill effects of frosty weather, and reminds one of the small sized species growing in high altitudes and having to endure low temperatures even during the nights of summer, as for example Alpine plants, Rocky Mountain plants, etc. Both our species occur in open woodlands, as is the rule with our vernal species of herbaceous plants. Blooming so early in the season, as they do, their small size is of no disadvantage to them; later on, plants of such dwarf-like appearance could not inhabit the same locality, without being concealed beneath a luxuriant growth of other herbaceous plants of greater size.

The first open flowers on the catkins of our willow species—*Salix discolor,* Muhl., appear in the second or third week in April, or even later. In the early spring of 1898, *Salix discolor* began its blooming period on April 12th, seventeen days later than *Trillium nivale* and exactly two weeks later than *Erigenia bulbosa*. The spring of 1899 was preceded by a prolonged period of unusually cold weather in the month of February, and accordingly our first vernal flowers were slow in making their appearance. But after the opening of the flowers of *Trillium nivale* on April 11th, and those of *Erigenia bulbosa* on the following day, April 12th, the season progressed very rapidly and brought out the first flowers of *Salix discolor* on April 17th, only five days later than *Erigenia bulbosa*.

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(5) C Robertson. Flowers and Insects. Umbelliferae. Trans. Acad. Sc. St. Louis, Vol. V. pp. 450-451.

The appearance of the first willow catkins, covered with blossoms, is an event of no small importance to the anthophilous insects, whose time of flight corresponds with the blooming period of our willows. One of the most important features of the willow-blossoms is the presence of catkins bearing only male or staminate flowers on one plant, and catkins with only female or pistillate flowers on a different plant. This distribution of the two sexes on two different plants is called dioecism, and is a contrivance by which cross-fertilization is made a necessity.

The willow family (Salicaceae) comprises the species, belonging either to the genus *Salix* (the willows) or to the genus *Populus* (the poplars, aspens), and the members of this family are without exception dioecious. The species of *Populus* are anemophilous. They depend on the currents of air to transport their pollen from the male flowers to the stigmas of the female flowers. Their flowers are neither fragrant, nor do they secrete nectar. They possess practically nothing attractive to insects, except, perhaps, the dry, smooth-coated pollen of the male flowers, which is not appreciated by insect visitors. The latter may be observed in exceptional cases on the male flowers of poplars, feeding on pollen, but their visits are of no advantage to the flowers, as the same insects never pay any attention to the female flowers.

The other members of the family, the species of *Salix* (the willows), have adopted entirely different methods to insure cross-fertilization. They rely for this purpose on the aid of insects. They are decidedly entomophilous. Owing to the abundant production of nectar and the fragrance of their flowers, they secure an ample set of visitors, and in addition to this their male flowers offer a full supply of damp, adherent pollen, which is a further source of attraction to pollen-collecting and pollen-eating insects. The flowers of our earliest willow, *Salix discolor*, Muhl., are well provided in this respect, and attract numerous visitors, belonging to widely separated orders of insects. These flowers are of a very simple structure, bearing no perianth, and being arranged in oblong cylindrical catkins. In this species the male or staminate flower consists merely of two stamens, arising from the base of a scale, and is furnished with a nectar-gland at the base. The female or pistillate flower is constructed exactly on the same plan, having a pistil instead of the two stamens. It is an easy task for any flower-visiting insect to gain access to the entirely exposed pollen, as well as to the nectaries of these simple flowers, and this fact, together with the rich supply of pollen and nectar in the numerous flowers, explains the frequency with which they are visited. Another point of advantage in attracting insects to the flowers, is the opening of the flowers of *Salix discolor* and of a few other early species of *Salix* before the green leaves of the stem appear. It is evident that the catkins of such a species are more conspicuous than those of a species producing the green leaves in advance of the flowers.

According to Kerner's (6) statements, the majority of dioecious plants are proterogynous. In referring to willows, this author mentions four European species, in which proterogyny has been observed, the pistillate flowers appearing from one to three days earlier than the staminate flowers. This condition of affairs favors, in the opinion of Kerner, the production of hybrids, as the very first pistillate flowers of such a species can not, during the first two or three days of their existence, be supplied with pollen of the same species, but may be fertilized by pollen from another species, whose staminate flowers are blooming at that time. From observations on *Silax discolor* during the last three years, I am satisfied that this species is proterogynous, the female flowers opening at least one day, and, as a rule, two days in advance of the male. In this species proterogyny can have nothing to do with the production of hybrids, as *Salix discolor* is our earliest willow, and, therefore, no staminate flowers of any other species are on hand during the proterogynous period of this plant.

As has been stated previously, the flowers of this willow are abundantly visited by a great variety of insects, and, on looking over the following list of visitors of *Salix discolor*, we come across the majority of anthophilous insects flying in early spring.

A. HYMENOPTERA.

Apidae: (1) *Apis mellifica*, L. ☿ s. and c. p. *; (2) *Bombus Edwardsii*, Cr. ♀, s.; (3) *B. Virginicus*, Oliv. ♀, s.; (4) *B. separatus*, Cr. ♀, s.; (5) *Osmia lignaria*, Cr.♂♀, s.; (6) *O. atriventris*, Cr.♀ , s.; (7) *Nomada integerrima*, DT.♂, s.; Andrenidae: (8)

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(6) A. Kerner von Marilaun. Pflanzenleben, Vol. II, pp. 311-313.

* ☿ Worker; ♂ Male; ♀ Female; s Sucking; c p Collecting Pollen; f p Feeding on Pollen.

Halictus similis, Sm. ♀, s.; (9) *H. fasciatus,* Nyl. ♀, s.; (10) *H. confusus,* Sm. ♀, s.; (11) *H. connexus,* Cr. ♀, s.; (12) *H. Pattonii,* Ashm. (M.S.) ♀, s.; (13) *Halictus sp.* ♀, s.; (14) *Andrena mariae,* Rob. ♂ ♀, s. and c. p.; (15) *A. illinoensis,* Rob. ♂ ♀, s. and c. p.; (16) *A. crythrogastra,* Ashm. ♂ ♀, s. and c. p.; (17) *A. vicina,* Sm. ♂ ♀, s.; (18) *A. bipunctata,* Cr. ♂ ♀, s.; (19) *A. crigeniae,* Rob. ♀, s.; (20) *A. Forbesii,* Rob. ♀, s.; (21) *A. rugosa,* Rob. ♂ ♀, s.; (22) *A. mandibularis,* Rob. ♂, s.; (23) *Parandrena andrenoides,* Cr. ♂ ♀, s. and c. p.; (24) *Colletes inaequalis,* Say. ♂ ♀, s.; (25) *Sphecodes dichroa,* Sm. ♀, s.; Vespidae: (26) *Polistes pallipes,* Lep. s.; Ichneumonidae: (27) *Ephialtes irritator,* F. s.; (28) *Glypta varipes,* Cr. s.; (29) *Glypta sp.,* s.; (30) *Meniscus parvus,* Cr. s.; (31) *Pimpla indagatrix,* Walsh., s.; (32) *Amblyteles sp.,* s.; Braconidae: (33) *Apanteles eupitheciae,* Ashm., s.; Tenthredinidae: (34) *Dolerus unicolor,* Beauv., s.; (35) *D. arvensis,* Say., s.; (36) *D. sericeus,* Say., s.; (37-38) *Pontania spp.,* s.

B. Diptera.

Syrphidae: (39) *Melanostoma obscurum,* Say.; (40) *M. mellinum,* L.; (41) *Syrphus americanus,* Wied.; (42) *S. ribesii,* L.; (43) *Mesograpta geminata,* Say.; (44) *M. parvula,* Loew.; (45) *Eristalis aeneus,* F.; (46) *E. tenax,* L.; (47) *E. Dimidiatus,* Wied.; (48) *E. meigenii,* Wied.; (49) *Helophilus similis,* Macq.; (50) *Crioprora cyanogaster,* Loew.; (51) *Syritta pipiens,* L.—all s. or f. p.; Conopidae: (52) *Myopa pilosa,* Will., s.; Phoridae: (53) *Phora femorata,* Meig.; (54) *P. rufipes,* Meig.; Tachinidae: (55) *Gonia capitata,* DeG.; (56) *Siphona geniculata,* DeG.; (57) *Tachina robusta,* Towns.; Muscidae: (58) *Calliphora crythrocephala,* Meig.; (59) *Lucilia caesar,* L.; (60) *L. cornicina,* Fabr.; (61) *Pollenia rudis,* Fabr.; Sarcophagidae: (62) *Sarcophaga sarraceniae,* Riley; Anthomyidae: (63) *Hyetodesia parsura,* Gig.-Tos.; (64) *Leucomelina garrula,* Gig.-Tos.; (65) *Phorbia fusciceps,* Zett.; (66-69) *Phorbia spp.;* Oscinidae: (70) *Mosillus aeneus,* Fallen.; (71) *Elachyptera nigriceps,* Loew.; Ephydridae: (72) *Ochthera mantis,* DeG.; Sepsidae: (73) *Sepsis violacea,* Meig.; (74) *Prochyliza xanthostoma,* Walk.; Sapromyzidae: (75) *Lonchaea polita,* Say.; Scatomyzidae: (76) *Scatophaga squalida,* Meig.—all s. or f. p.

C. Lepidoptera.

Phopalocera: (77) *Vanessa atalanta,* L., s.; (78) *V. milbertii,* Gdt., s.

☿ Worker; ♂ Male; ♀ Female; s Sucking; c p Collecting Pollen; f p Feeding on Pollen.

D. COLEOPTERA.

Coccinellidae: (79) *Adalia 2-punctata,* L.; Chrysomclidae: (80) *Diabrotica vittata,* S.; Curculionidae: (81) *Smicronyx corniculatus,* F.—all s.

E. HEMIPTERA.

Capsidae: (82) *Lygus pratensis,* L.; Pyrrhocoridae: (83) *Dysdercus, sp.;* Lygaeidae: (84) sp.—all s.

The vast majority of the visitors is made up of the hymenopterous insects (mostly bees) and flies taken together, the hymenoptera being represented by thirty-eight species, as are also the flies by thirty-eight; these two orders together giving a total of seventy-six species, and leaving only eight species to be distributed among the remaining three orders in the following proportion, two butterflies (Lepidoptera), three beetles (Coleoptera), and three bugs (Hemiptera).

Among the bees we notice seven species of the highly specialized or long-tongued bees of the family Apidae, and most prominent among these are three species of *Bombus* (bumble-bee), which, at this early period, are present in the female sex only, the workers and males appearing much later in the season. The honey-bee *(Apis mellifica,* L.) is a frequent visitor, especially on the staminate catkins, sucking honey and collecting pollen, but is in our part of the country never present in such numbers as to monopolize the staminate catkins and drive off most of the other visitors from the staminate flowers, as has been observed by Robertson (7) in Southern Illinois on *Salix humilis,* Marsh., an early flowering willow. The three remaining species of the higher bees are two species of *Osmia,* bees having the pollen-collecting apparatus on the lower surface of their abdomen and one species of *Nomada.*

Of all the insects frequenting the willow-blossoms, none attain such an importance as the less-specialized bees—the Andrenidae. Eighteen species are credited to this family, the majority of them belonging to the genera *Andrena* and *Halictus* and leaving only one species to each of the remaining genera—*Parandrena, Sphecodes* and *Colletes.* Many species of *Andrena* have their time of flight during the spring months, and depend to a great extent on the flowers of the different willow-species for their supply of honey and pollen. A few species of *Andrena* and our single species of *Parandrena* rely even exclusively on willow-blossoms for their supply of pollen, and are never observed collecting pollen on any other plant than on certain species of *Salix,* although they resort to other flowers for nectar. A bee obtaining pollen from one plant-species exclusively, or from a limited number of closely related species, has been called by Loew (8) an oligotropic bee, and for a bee that collects pollen on an extended number of species, belonging to different families the same author has selected the name polytropic. Robertson (9), in a paper on the visits of oligotropic bees refers to five oligotropic bees taken on four species of *Salix* in Macoupin County in Southern Illinois, and four of these I have observed on the flowers of *Salix discolor,* where they appear as regular and frequent visitors. Their names are *Andrena mariae,* Rob., *Andrena illinoensis,* Rob., *Andrena erythrogastra,* Ashm. and *Parandrena andrenoides,* Cr., and they may be seen on the flowers in both sexes, the females paying more attention to the staminate catkins in search of pollen and nectar, and the males visiting both staminate and pistillate catkins for nectar only.

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(7) C. Robertson. Flowers and Insects. XV. Bot. Gazette, Vol. XXI (1896) p 78.

The willows which furnish pollen to these oligotropic bees are of vital importance in the economy of these bees, the latter utilizing the pollen mixed with honey as food for their offspring, and depending strictly on the pollen produced by willows for their purposes. On the other hand, the existence of these bees is of great advantage to the willows, furnishing them a set of regular visitors, which need an ample amount of pollen, as well as of nectar, and which for this reason can be relied upon to visit both staminate and pistillate flowers, thereby rendering excellent services as cross-fertilizers.

In favorable weather the Andrenidae visit the catkins of *Salix discolor* in great numbers, and they, together with members of the most important family of anthophilous flies—the Syrphidae—represent a high percentage of the visitors. Wherever observations have been made, in this country as well as in different localities of Europe, the results always point to the Andrenidae and Syrphidae, as being the most prominent agents in effecting cross-pollination in the willows. Of the eighty-four insects making up the list for *Salix discolor,* thirty-one belong to these two families, amounting to 37 per cent. of the visitors. A comparison of these figures with those obtained by Robertson (10) in Southern Illinois, by Herman Mueller (11) in Germany, and by MacLeod (12) in Flanders on several early species of *Salix*, gives the following results:

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(8) E. Loew. Beobachtungen ueber den Blumenbesuch von Insecten an Freilandpflanzen. Jahresb. d Bot. Gart. Berlin, Vol. III, 1884,

(9) C. Robertson. Flowers and Insects. XIX. Bot. Gazette, Vol. XXVIII (1899) p. 36.

(10) C. Robertson. Flowers and Insects. XV. Bot. Gazette, Vol. XXI (1896) pp. 76-78.

(11) H. Mueller. Die Befruchtung der Blumen durch Inseckten. 1873. pp. 149-150.
" Weitere Beobachtungen Vol. II, 1879, p. 210.

(12) Mac Leod. Over de bevruchting der bloemen in het kempisch gedselte van Vlaunderen. Bot. Jaarboek 6, pp. 129-133.

	Locality.	Visitors	Andrenidae + Sysphidae.	Per Cent.
Salix Cordata, Muhl	Southern Illinois	87	49 =	56
Salix Humilis, Marsh	Southern Illinois	51	27 =	53
Three Early Species	Germany	113	61 =	54
Early Species	Flanders	43	15 =	35
Salix Discolor, Muhl	Milwaukee, Wis.	84	31 =	37

Several species of Syrphidae are in attendance on the willow-flowers most of the time in pleasant weather, and this is especially true of two very common species—*Eristalis dimidiatus,* Wied. and *Helophilus similis,* Macq., which are occasionally so numerous on the flowers that they surpass the rest of the visitors, as far as the number of individuals is concerned. On April 23d, 1897, I saw plants of *Salix discolor,* growing near the city limits in Bay View, literally swarming with flies, belonging to these two species of Syrphidae. Although the Syrphidae take such a prominent part in the pollination of the willow-flowers, yet there are no close mutual relations existing between these flies and the willows, as we have seen to exist between these plants and the Andrenidae.

Having considered the more important groups of visitors of *Salix discolor,* it remains for us to turn our attention to the other visitors on the list. The only wasp observed on the flowers is a female of our social wasp, *Polistes pallipes,* Lep.; none of our other species of wasps appear so early in the season, the solitary wasps notably coming out much later. The remaining hymenopterous insects of the list are made up of seven parasitic Hymenoptera, chiefly Ichneumonidae and five Tenthredinidae (saw-flies). The visitors belonging to these families are of little importance, compared with the other Hymenoptera, and are only occasionally taken on the flowers.

Among the flies we have in *Myopa pilosa,* Will., a single species of the Conopidae, a family ranking as high as the Syrphidae, as regards the adaptation of its members to flowers, but having comparatively few representatives in our region.

Of the three species of Tachinidae, we have already come across two *(Gonia capitata,* DeG. and *Siphona geniculata,* DeG.) among the earliest Diptera, visiting *Erigenia bulbosa,* and the third *(Tachina robusta,* Towns.) is a good-sized fly, which appears regularly, though in small numbers, on the flowers of *Salix discolor.*

The remaining species of Diptera are scattered among different families, none of which produce anthophilous species in the strict sense of the word. These species do not depend on floral diet, although some of them, as for example those belonging to the Muscidae, Anthomyidae and Scatomyzidae are frequently observed on the willow-catkins, and most certainly contribute their modest share of work in effecting pollination. The smaller flies of the families Phoridae, Sepsidae, Oscinidae and others visit the flowers in search of nectar, but can not be relied upon to render efficient services, as, on account of their small size, they can crawl down to the nectarglands, without necessarily coming in contact with either the anthers or the stigmas.

This same consideration applies to the small-sized species of beetles and bugs, while the large species of these orders, as well as the butterflies, may be expected to carry pollen to the stigmas, if they visit the flowers in the appropriate order; that is, if they visit the staminate catkins in advance of the pistillate. The staminate catkins, with their numerous yellow anthers, are undoubtedly more conspicuous than the pistillate and, besides, they offer both pollen and nectar to the visitors and may, for these reasons, be expected to be more attractive to insects than the pistillate catkins, which are provided with nectar only. Observations establish the fact that insects are more numerous on the male (staminate) flowers than on the female, and there is a probability of the visitors paying their attention to the male flowers before visiting the female.

Before closing these remarks on *Salix discolor* and the throng of insects feasting on the sweets of its flowers, it remains for me to state, that the latest flowers of this species may be observed in the first week of May, and that, during its blooming period, several other entomophilous flowers make their appearance, as for example additional species of *Salix,* two species of *Hepatica,* two species of *Erythronium, Dirca palustris,* L., *Sanguinaria canadensis,* L., *Claytonia virginica,* L. and *Isopyrum biternatum,* T. & G. Although, as the season advances, anthophilous insects become more numerous, yet competition among the gradually increasing number of entomophilous plants becomes more severe, and accordingly the blossoms of *Salix discolor* are not visited so abundantly towards the end as during the first and second week of its blooming period.

Additional Observations on the Instincts and Habits of the Solitary Wasps.

By G. W. and E. G. PECKHAM.

Chlorion coeruleum Linn.

C. coeruleum is an old friend of ours and we have given some account of its habits in an earlier work,* but we were anxious to learn more about it, and when, one morning in the middle of August, we saw a female running along with a cricket in her mouth, we were only too happy to drop our dignity and run after her. She led us a rough race down a steep declivity at one side of the island to her nest, which was entirely hidden from view by long grass, there being nothing whatever to indicate its presence. The cricket was deposited and the wasp flew away without circling, but it seemed that we were not the only ones who were interested in her actions, for immediately after we saw a little dark colored wasp come slipping along through the grass and into the nest. All remained quiet until, at the end of half an hour, *coeruleum* returned with a cricket. We had pushed the grass back to get a view of the entrance and this disconcerted her, for she ran about for some time seeming doubtful about the place, but she finally entered, head first, carrying the cricket with her. A moment later there was a commotion down below, and the inquiline came out shaking her wings in a flippant way as though she cared nothing for an encounter with the big blue *Chlorion*. We tried to catch her, but she ran off under the grass. Twenty-five minutes passed, and we began to think that the little wasp had wounded the big one, when *coeruleum* appeared. She stood in the doorway turning her head now to this side and now to that, as though listening, and now we became conscious of the fact that a cricket was chirping loudly near by. Perhaps she was getting the direction from which the sound came, for after a little she flew to the top of a tall weed, then dropped and entered a hole below, from which she issued a moment later with a very limp specimen of *Gryllus abbreviatus*. An ant, that indiscreetly showed some interest in her proceedings, was chased away with great vindictiveness, and then the cricket was laid upon its back and scraped, four or five times, from head to tail, with her mandibles. She then picked it up and carried it toward the nest, but laid it down on the way, and repeated the scraping operation, before taking it in. When it had been stored, and we had seen her run hunting up the hillside, we left her, but an afternoon visit, on the same day, found her still working industriously, storing from two to three crickets an hour.

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* Instincts anl Habits of Solitary Wasps, Madison, 1898.

As we had had some acquaintance with this wasp, and knew that the larva needed only five crickets to carry it through, it became evident that the one we were watching was provisioning several cells. Our curiosity in the matter being aroused we took up our station beside the nest early on the following morning. Madam *Chlorion* was still asleep down in one of her lower galleries, while the upper tunnel was occupied by an unsuspecting cricket that had crept into this shelter to pass the night, all ignorant of the proximity of its deadliest enemy. When the wasp came up from below it scrambled out and scuttled off through the grass in a great hurry. It was probably quite safe, however, for *coeruleum* does not sting a cricket unless she has gone through the preliminary act of hunting for it. A little later in the day we provided one for her and put it down into the hole when we saw her approaching, but instead of making use of it she brought it out, carried it to some distance, and set it free, quite unharmed.

On this morning she came out of her nest at fifteen minutes before nine, made a careful survey, on foot, of the surrounding grass, weeds, sticks and stones, and then flew away. Half an hour later she came back without a load and made another study of the locality. Then she began her day's hunting, running up the side of the hill and poking her head into every hole and tangle that might afford shelter to a cricket. From twenty minutes after nine until fifteen minutes after one she worked very industriously, taking one rest of half an hour in the middle of the morning, and in that period of four hours she brought in sixteen crickets. The length of time occupied in capturing and storing each one may be reckoned from the hours at which she returned to the nest, these being as follows: 9:27, 9:45, 10:10, 10:18, 10:35, 10:40 (she must have spent this hour rather easily), 10:55, 11:00 (here she passed half an hour in her nest), 11:45, 11:55, 12:10, 12:20, 12:40, 12:55, 1:05, 1:15. At the end of this stretch of work she flew away and had not returned at two o'clock, when we took our departure.

Only once did we see this wasp deliver her sting. When she started on her hunting expeditions she usually began close by, going either up or down the hillside, running over the ground or making short flights, so that we were able to keep track of her for some little time. On one of these occasions we saw her dislodge a cricket which tried to escape by hiding under some brush. She pursued, there was a slight scrimmage in which the sting was doubtless used, for when she pulled it out it was quite limp and helpless. She held it in her mandibles with its back up and gave it a very prolonged sting under the neck, before carrying it home. While carrying another cricket toward her nest she paused by the way, and clasping its neck in her mandibles, gave it one long tight squeeze.

In coming home this wasp almost invariably approached the nest by one particular path. She would alight upon a stump some eight or ten feet distant, and would then descend into the long grass and follow the runway which passed through it, her progress from the stump into the hole being entirely screened from any but a very observant eye. The other wasp of this species which we had watched, had a nest on a bare spot of ground with no protection of any sort, and made it even more conspicuous by leaving unscattered the heap of earth pellets which she had carried out. The difference may be partly accounted for by the fact that the grass-grown nest was evidently in a large natural cavity which ran deep into the ground, so that whatever excavation was necessary could be carried on out of sight.

It is evident from these observations that *Chlorion* does not make a new nest for each egg, but that, like *Cerceris, Philanthus* and others, she provisions a number of cells leading from one main gallery.

Pompilus atrox Dhalb.

While we were working on the island, one morning late in July, we saw a large wasp enter a natural crevice in the hillside. She was new to us, and although she came out and flew away almost immediately, we resolved to watch the spot in the hope that she had something more than a momentary interest in it. After a wait of two hours she appeared again and made another brief visit to the hole, showing that she had, in all probability, selected it for a nesting place. This second visit took place at noon, and we saw no more of the wasp that day, although we remained on guard until four o'clock. On the following day she visited the spot three times before two o'clock, when a heavy rain came on, and drove us to shelter. The next morning found us on hand early, for we thought that the storing of the nest could not be delayed much longer. At nine o'clock the wasp paid the place a short visit, and again at half past ten we saw her approaching, this time with even more than the usual signs of excitement. She was a really beautiful creature, instinct with vitality and the impersonation of grace and energy, the red spots on her body flashing and the steel-blue wings quivering in the sunlight. After a brief inspection she ran to the edge of the grass eight feet away, and, going backward, dragged out a large spider, which was held by the under and hind part of the cephalothorax. She took her victim into the nest, and remained within for half an hour. When she came out we captured her, but, although we dug up the place, we failed to find the spider.

Sphex ichneumonea Linn.

This great *Sphex* is so striking in appearance that we never see her without a pleasurable excitement, and this feeling is intensified when we find her actually engaged upon the serious business of life. In the summer of 1896 we had seen her dig out her nest, but three years had passed without a similar experience, when, on a sunny August morning, we found a large, suggestive looking hole which bore the marks of recent labor, a pile of fresh earth being heaped to one side of it. A whirr of wings and a flash of yellow soon announced the arrival of the big *Sphex,* who at once resumed her task with a great show of energy, and kept at it persistently for an hour and a half. It was half past eleven o'clock when she departed in search of her prey, and she did not return with it until fifteen minutes before one, when she appeared on foot carrying her big meadow grasshopper over the bushes and weeds. The burden was laid down at the doorway while the wasp ran into the nest, out again, then off to a little distance and back, finally seizing it by an antenna and dragging it within. All this we had seen before, but at this point, in our former observation, we had interrupted the natural course of events by opening the tunnel and carrying off the grasshopper with the egg of the wasp upon it. We now proposed to see the final closure of the nest, but to our surprise the wasp took in only a little earth—enough to fill the opening of a single cell—and leaving the main entrance wide open, departed with a comfortable air of "duty performed." We had supposed that each nest of *Sphex* served as the repository of a single egg, but this conduct suggested that several cells might be made, on successive days, leading from the main passage-way, each cell being stored with a grasshopper, and this proved to be true. On the following day, August tenth, we found our wasp at work upon a second cell, but did not wait to see it filled. On August eleventh the rain fell heavily excepting for an hour or two in the middle of the day, and we did not visit the nest. On the morning of the twelfth we found her working, presumably at a third cell. She stored a grasshopper at a little before twelve o'clock, and then filled the tunnel up solidly, evidently having concluded operations in this locality.

We did not open this nest until the eighteenth of August, when we found only two of the cells, one of these containing a freshly spun pupa, and the other a larva that was still eating. This one was well grown and had probably hatched from the egg laid on the eleventh.

Tachysphex tarsata Say.

On the afternoon of the twenty-first of July we saw this little red wasp on the *Bembex* field of the island. She had a very worried air and was running about wildly and rapidly, holding a small grasshopper with the third pair of legs. She let it drop four or five times and when she picked it up again she seemed to sting it, but of this we were not quite certain. At last she left it and began to rush about investigating the *Bembex* holes, entering one of them, and perhaps throwing out a little dirt, as though she intended to use it, and then hurrying off to another. We have no doubt that her confusion was the result of her having lost track of the hole that she had made, or selected, as was the case with *P. quinquenotatus* in one of our earlier observations.* The *Pompilus,* after a long search, resigned herself to the necessities of the case and made a new nest, but this little wasp could not adjust herself to a break in the system of her instinctive activities, and at last deserted her prey and disappeared. We waited for an hour, and then, as she did not return, we took possession of the grasshopper. It gave no response to stimulation, and never revived, a very careful and thorough examination later on showing that it was quite dead.

On the next morning we again saw this wasp on the *Bembex* field. She was looking for a nesting place, and presently selected one and began to work. The weather was warm and sunny so that the Bembecids were in the full swing of their obstreperous activity, and, perhaps, resenting the presence of the little red wasp as an intrusion, or perhaps in a spirit of teasing, they kept snatching her up and carrying her off to a distance of two or three feet. She took these interruptions with the most philosophic composure, hurrying back to her work as soon as she was released without any display of resentment. When the nest was finished she made a careful locality study, both on foot and on the wing, and then flew away. Twenty minutes later she came back, apparently to refresh her memory, for she again made careful notes of all the points that could help her to identify the place. She dug a little more, and then again departed, to return five minutes later on foot, with a grasshopper. In spite of all the precautions she had taken, at this exciting moment she was unable to remember just where her nest was, and spent some time in running wildly about, but when she did find it she went in without any delay. We caught her as she came out, and then dug out the grasshopper, but found no egg, so that she would probably have brought in a second victim had we let her go. The tunnel ran in obliquely for an inch and a half, the pocket at the end being two inches below the surface.

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* Instincts and Habits of Solitary Wasps, p. 135.

Cerceris fumi-pennis Say.

While working on the island on July twenty-third we noticed a large, open nest in a very bare, exposed position. The hole was surrounded by the heaped up earth that had been removed, giving it the characteristic appearance of *Cerceris*. We spent several hours in the vicinity, both on this day and the next, but caught no glimpse of the owner. On the morning of the twenty-fifth we were at work early, and saw her open the nest at half past nine. At ten she flew away, leaving the hole open, and forty-five minutes later she returned with a large beetle, *Chrysobothris 4-impressa*, which, while on the wing, she carried in her falces, supporting it by all the legs. When she alighted she let down the second and third pairs of legs. We caught her and took the beetle, which was quite dead, since we tested it closely during the next twenty-four hours without getting the slightest response to stimulation.

Ammophila polita Cresson.

This species, which we have never seen at Pine Lake, is very common in the sandy fields to the south of Milwaukee. Our observations upon it were made on the tenth of September, in bright, clear weather. Half a dozen individuals were working within a few rods of each other, their method being similar to that of *A. yarrowii*, described by Dr. Williston, and having an especial interest as it shows a transition stage between the wasps that provide the store of food for the larva all at once, and those that feed their young all through the larval period. *A. urnaria* rarely flies with her prey, but this wasp, although her caterpillars are not very much smaller, and she herself is no larger, carries her booty lightly on the wing, only occasionally alighting to run a few steps. She has to do more work than *urnaria*, taking five or six caterpillars instead of two, and this method of progression has the advantage of rapidity.

The first wasp that we saw was just alighting, with a medium-sized green caterpillar, near a partly closed nest. When disturbed she flew away, but soon returned, dropped her prey half an inch from the nest, proceeded to clear the opening, ran inside to see that all was right, and then backed in with the caterpillar. Emerging after a few minutes she placed a small pebble in the doorway, which was thus partly closed, and flew away. She brought three more caterpillars at intervals of about thirty minutes, and then, after wedging a pebble into the neck of the opening, she began to fill it in solidly, scratching in dirt and packing in lumps of earth which were brought in her mandibles. We did not allow her to complete this operation, as it would have made excavation more difficult, but caught her and dug out the nest. The tunnel ran down obliquely for five inches, being two inches below the surface at the pocket. In it we found a wasp-larva which was at least three days old, and the four caterpillars. There were no signs of the banqueting that must have already taken place. We carried this larva home with us and it ate the caterpillars up clean, finishing with a fifth which we supplied from another nest, and going into its cocoon on September sixteenth. The additional food would probably have been brought by the mother had we not interfered. The caterpillars all wriggled about upon the slightest stimulation, and remained in this lively state until they were eaten. They belonged to four different species.

In a second nest to which food was being carried, we found four caterpillars and a larva about three days old, all the conditions being like those in the other example. Evidently the larva had been fed from day to day, since four or five days must have elapsed since the making of the nest.

Odynerus capra Sauss.

We had often seen this wasp gathering earth on the very hard clay and gravel path that leads to our boat house, but had always failed in our efforts to follow her to the nesting place. Even when we called in our auxiliary force of children and stationed them with the greatest care as to their positions, she baffled our pursuit, disappearing among the foliage of the thickly wooded ravine at one side of the path. However, her fearlessness and her tendency to utilize any convenient crevice at last betrayed her.

One of our neighbors in the country keeps a large tin horn hanging under the porch. One day when she wished to use it no amount of blowing would bring forth a sound, and when she unscrewed the mouth piece to investigate the matter, out tumbled several small green caterpillars and a quantity of dry mud. When we heard of this incident we begged that, if it should be repeated, the nest and its contents might be saved for us, and on the second of September we received the mouth piece of the horn with a message to the effect that a wasp had been working at it for some days and had just closed it up. Examination showed that there were three cells, each containing larva and a supply of caterpillars, of which there were ten in the cell most lately formed, and only one left uneaten in the oldest. The caterpillars, all of them being alive, together with the wasp larva, were transferred to a place in which they could be conveniently watched. None of the caterpillars died until they were attacked. The larva ate all the food that was provided, the oldest one cocooning on the fourth, and the second one on the seventh of September. Of the third we have no record, excepting that the caterpillars had all been eaten on September eighth.

We happened to be passing through our neighbor's grounds at nine o'clock on the morning of September fifth, and calling to ask whether there had been any more visits from the wasp, we learned that an *Odynerus* had been seen making a mud partition in the horn on the day before. While we were speaking she arrived and entered the mouth piece, where she remained for about ten minutes. When she departed we found that she had laid her egg, which we carried away with us, wishing to determine the length of the egg stage. This proved to be longer than that of any wasp that we had heretofore known, for not until the morning of September ninth did the larva make its appearance, and then the hatching was accomplished in a manner new to us, the egg-skin bursting and leaving its tenant free to crawl away. As a usual thing the egg changes into a larva imperceptibly, there being no sloughing off of the skin.

Odynerus capra, then, first finds a suitable crevice and builds an earthen partition across the inner end, the earth being scratched up from some dry, bare spot and moistened in her mouth. In this her habits seem to be identical with *O. nidulator,* which is described by Fabre as building in natural crevices or in those excavated in the stems of plants by bees. She then lays her egg, very probably suspending it by a filament of web, as is done by *O. nidulator* [*] and *O. reniformis,*[†] as well as by *Eumenes.*[‡] Not until this is done does she gather the ten or twelve small caterpillars which are to serve as food for her young. One cell being provisioned, others follow until the crevice is filled. The caterpillars are not killed, nor even reduced to a state of decent immobility, since we were obliged to press wads of cotton into the tubes in which they were kept to prevent their wriggling out of reach of the wasp-larvae. In the case of *O. nidulator* the caterpillars, according to Fabre, are so severely stung that they are reduced to absolute immobility. Not the slightest response is given to stimulation, and had the observer only this test to depend upon they would be pronounced dead. In *O. reniformis*, on the other hand, and to a somewhat lesser extent in *Eumenes*, the con-

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(*) Fabre. Souveners Entomologiques. Quatrieme Serie. 1891, p. 179.
(†) Id. Nouveaux Souveners Entomologiques. 1882. p. 89.
(‡) Id., ibid. p. 74.

dition of the caterpillars is like that which we find in *O. capra*. Fabre, in discussing the theory of natural selection, considers it a fact of immense importance that in these species the egg and young larva are so placed as not to be imperilled by the wriggling of the caterpillars. He thinks that if the egg, so delicate that the least pressure would crush it, were placed among the mass of caterpillars, nothing could save it from destruction. Certainly the adaptation does seem to be a peculiarly beautiful one, but where is the necessity of it in the case of *nidulator,* whose caterpillars never move at all? And is it, after all, so important in the case of the other species? The caterpillars of *capra* were in the same threateningly active state that was found in those of *reniformis,* and yet the wasp-larvae which we dropped in among them, even the youngest, which could not have been more than a day old, were not in the least harmed by their contortions. The egg stage of *capra,* like that of *nidulator,* is four days, and the larval stage is probably six or seven.

Physiographical Field Notes in the Town of Wauwatosa.

By ERNEST BRUNCKEN.

1.—Boulder Clay and Lacustrine Deposits.

On one of the maps accompanying the first geological survey of Wisconsin there is indicated between the main body of the boulder clay and the lower red clay, in Milwaukee County, a strip of clay deposit of lacustrine origin, but differentiated from the red clay by its physical and chemical properties, and especially the greater abundance of pebbles. The map does not purport to show local details. But it would be a mistake to imagine that within the territory assigned to this deposit the lacustrine clay occupies the entire surface. The fact is, that areas of lacustrine clay, and areas of boulder clay, alternate very frequently everywhere in the Town of Wauwatosa, to which these notes principally relate, as well as on the West Side of the City of Milwaukee.

A complete mapping of the relations of these two formations, if it were worth while, would be impracticable for the reason that grading and filling operations have in many places radically changed the character of the surface. But from observations which can be made without mapping the following facts can be learned:

Generally speaking, the northeastern portion of the territory under discussion is a gently rolling plateau, dissected by the valley of the Menomonee. The southeastern portion, without being in bold relief, is yet much more broken. The hills are mostly drumloid in character, but the typical drumlin form is often modified in a particular manner to be indicated forthwith. The presence of drumloids is not surprising in this locality. This form of glacial accumulation is usually found near the outer rim of a glacial lobe, and the outer rim of the Michigan glacier, as indicated by the moraine dividing the Michigan and Green Bay lobes, is but a few miles to the west. The longer axis of the hills is generally from northeast to southwest, in accordance with the flow of the glacial ice in this locality. As far as I know there is but one place within the town where the hills are of a different character. This is in the grounds of the Soldiers' Home, where they are of kame-like appearance.

All these hills are without doubt of glacial origin. Their surfaces are covered with boulders, mostly crystalline. Where cuts and other exposures have been made sufficient to show the internal structure, the aspect is always the same. There is an irregular accumulation of clay, sand, gravel and boulders of varying size. But surrounding these hills, filling the depressions between them and ascending their sides, there is the deposit of grayish clay (1), with comparatively few pebbles and only an occasional boulder. which is indicated on the map. This deposit shows a fairly distinct stratification, but considerable exposures of it are infrequent. The largest are those made by the brick yards in the Menomonee Valley. About the aquatic origin of this deposit there can be no doubt, nor about the fact that it is younger than the boulder clay. This being so, the interesting feature is that all the highest places of this neighborhood show the boulder clay as their surface deposit. In some cases, the lower hills may have a lacustrine clay surface like the depressions. I have noticed no exposures showing this, but have suspected it from the scarcity of boulders. But without question all the higher hill tops are boulder clay.

The obvious conclusion to be drawn from this circumstance is, that at the time when the lacustrine clay was deposited, the boulder clay hill tops were islands, and the lower hills with a lacustrine clay surface, if such there are, were shoals. This fact explains the greater quantity of pebbles and the relatively large number of boulders in this formation, compared with the red clay to the eastward. The latter was deposited in open and deep water, while the former was laid down in narrow seas, where there was a great deal of material washed down from the land, both by direct erosion and with the help of ice rafts. In some places, notably the ravines on the north side of the Menomonee Valley, there appears to be a stratum of boulder clay overlying the lacustrine. This is easily explained by material rolling down the sides of the hill, either while the lower deposit was still forming or, more probably, after it had become dry land.

The existence of an archipelago of boulder clay islands on the west side of Milwaukee and in the town of Wauwatosa during Champlain times is still further evidenced by the existence of another formation, occupying a middle ground between the boulder clay and the lacustrine clay. In a large number of places, but invariably on the side of one of the hills, there are large accumulations of sand and gravel, which are now often used as gravel pits. These accumulations have the evident ear-marks of being beach deposits. They are very distinctly stratified, but show the cross-bedding characteristic of beaches. The material is usually composed of alternating strata of sand, varying in fineness up to the size of a pea, and gravel consisting of flat, well-worn pebbles. The fact that these deposits occur on all sides of hills, and that their strike and dip is in all sorts of directions, preclude the idea that they indicate a continuous coast line. For the same reason they cannot be identified with the various beach formations indicated along the present shore of Lake Michigan by the Geological Survey. The only alternative seems to be that they were formed around islands, while the clay was deposited in the deeper portions of the straits throughout the archipelago.

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(1) The term "clay" is used in this paper in its popular rather than its technical sense, meaning a fine-grained, cohesive earth. I do not know whether pure aluminous clay occurs in this neighborhood. Most of the clay, so-called is decidedly marly.

Some caution is necessary in identifying quaternary deposits in this region. As a general rule, we may classify all formations showing distinct stratification as Champlain rather than Glacial. But this does not always hold true. It is well known that the Till not rarely shows limited areas of pure clay, without pebbles or boulders, or of sand and gravel. Not rarely, also, there is an imperfect stratification visible. Where the exposure is large, mistakes are not likely to happen because such areas are usually small and surrounded on all sides by unmistakeable boulder clay. But in small exposures it is sometimes impossible to come to a positive conclusion. Among the tests must be, aside from the general topographical relation of the area, the character of the pebbles, which in the Till are subangular, but in the beach deposit worn more or less flat. In the lacustrine clay, the pebbles may be of either kind, according to their history. The stratification within the Till is usually irregular, often crumpled, while the strata of the lacustrine clay are regular and approximately horizontal.

These accumulations on the sides of the boulder clay hills have of course materially changed the outlines of the latter. It is noticeable that the farther southwest one goes within the township the more distinctly drumloid the hills appear. In the eastern portion they are often broad, while towards the west they are often elongated beyond the typical drumloid form. The western half of the township offers less favorable opportunities for studying the quaternary formations, because there are not so many cuts and other artificial exposures as in the portions nearer the city. It is not at present practicable to say precisely how far west the archipelago extended. The mainland must, of course, be held to have begun where the boulder clay commences to be the continuous surface deposit of the hills as well as the depressions, which, according to the map, is somewhere near the county line.

2.—Quaternary Deposits and Bedrock.

As is well known, natural exposures of the Niagara limestone are very rare in the neighborhood of Milwaukee. In fact I believe there are only two to be found in the county: One is in the Menomonee River bed, just below the Wauwatosa Sanitarium; the other is the little cliff which projects in the shape of a triangle in a northeasterly direction from one of the bluffs in the Soldiers' Home grounds into the flats of the Menomonee Valley. The rock here forms the base of a rounded gravel hill which crowns it like a dome. This gravel hill is the outermost of a group of similar hillocks, which within these grounds form an area of the nature of kames, as far as I know the only occurrence of such a structure in this vicinity.

How did this little exposure take its origin? The theory which suggests itself first of all is, that it is an ancient sea-cliff. It stands on the edge of a circular valley, surrounded on all sides, except the east, where it connects with the plain of the present Menomonee River, by bluffs of considerable steepness. The fact that there is a narrow terrace on the inside of this semi-circle of bluffs, several feet higher than the general level of the valley, adds rather than detracts from the plausibility of the suggestion, for such terraces are a common shore form.

But a closer inspection of the rock itself quickly refutes this theory. As stated above, the exposure has the shape of a V, with the apex towards the northeast. The easterly face might possibly be shaped by the action of waves, for it is almost vertical as sea cliffs, formed by undercutting, usually are. But the other face presents smooth planes, slanting back at an angle of about 45 degrees. These planes are roughened by weathering. They could not possibly have been formed by wave action. What, then, is their origin?

Observations on some phenomena in another place in the vicinity may suggest the true explanation. Less than half a mile to the north from this cliff is the quarry of Story Bros. It is located at the base of the bluff forming the west bank of the Menomonee Valley. A portion of the discrete of which this bluff is composed has been removed, laying bare the surface of the bedrock. This surface is elevated in the neighborhood of twenty feet above the general level of the valley. The quarry itself constitutes a deep hole, sunk far below that level. Evidently the bedrock formed a low hill, the eastern portion of which has been cut away in making the quarry. This leaves the line of contact between the glacial deposits and the bedrock plainly visible on the west side of the quarry. Tracing this line one notices first of all that the surface strata are very sound. There is hardly a trace of weathering, no layer of "rotten" stone. Furthermore, the line is very even, forming a low, vertical curve, highest in the center and descending gently to north and south. The bedrock, therefore, seems to have formed in this place a low dome, worn smooth on its surface, in other words, a huge *roche moutonnee.* On the top of this the boulder clay was deposited. There is nothing to indicate, in the present condition of the exposure, whether the abrasion of the surface took place during an earlier stage of the same glacial invasion which deposited the Till, or had been completed before the last invasion began. It is generally admitted that the Till of this neighborhood, in its present arrangement, belongs to the youngest or Wisconsin epoch of the ice age. If more of the surface of this *roche moutonnee* should be uncovered, an examination should be made to ascertain whether any weathering had taken place. If none at all could be found, it would indicate that there was no interval of exposure between the abrasion and the deposit of Till. If there has been weathering, the amount of it may throw some light on the mooted question of the length of time elapsing between the successive glacial deposits.

The existence of the *roche moutonnee* at Story's quarry suggests that the peculiar configuration of the cliff at the Soldiers' Home is caused by its being the somewhat irregular edge of a similar ice-worn dome. As to whether the existence of the kame-like group of hillocks at this place has a causal connection with the surface configuration of the bedrock, I am not able to form an opinion.

Botanical Notes from the Green Bay Peninsula.

By ERNEST BRUNCKEN.

The shores of Lake Michigan, meaning thereby the beach and the zone immediately behind it, be it cliff, terrace or ridge, constitutes one of the most distinctly defined biological districts of this state. Its study has hardly been begun, but will richly repay the student of ecological and biogeographical phenomena. The following random notes may be of use for this purpose.

The western or Green Bay side of the Door County peninsula, north of Sturgeon Bay, is well known for its picturesque limestone cliffs, which in some cases descend directly into the water, while in others there is an interval of from a rod to a third of a mile of foreland between the water's edge and the cliff. This foreland is composed of fragments of stone, coming evidently from the cliff talus, together with beach sand and soil formed since vegetation has clothed it. This material is heaped up, in many places, in one or more beach ridges. The uplands, above the limestone cliffs, show the usual glacial drift formations. A characteristic of the region is the fjord-like incisions into the shore lines, which have often been described.

The entire peninsula was, before settlement, heavily wooded. But there is a very striking contrast between the vegetation of the main body of the district and the foreland on the Green Bay side. The upland forest was principally of hardwood, with hard maple and beech predominating. Swamps in the depressions are occasionally found, covered with black spruce or tamarack. On a ridge following the east shore for some six miles north of Sturgeon Bay, there was pinery, composed of white and Norway pine. This is now mostly cut and burned over, and presents the usual aspect of a young growth of aspen, together with underbrush composed of fire cherry, *Amelanchier*, etc. In the shade of these weeds, young pine is coming up everywhere, and will soon overtop the aspen.

In contrast to these formations, typical foreland localities, such as may be found, e. g., at Egg Harbor and Fish Creek, are conspicuous, first of all by the almost total absence of broad-leaved trees. *Thuja occidentalis*, the arbor vitae, is by far the most numerous tree in these places. It grows both in dry and moist places, reaches considerable height, and individuals a foot and more in diameter are common. The next tree in order of frequency is *Abies balsamea,* which seems to reach greater dimensions here than elsewhere in the state. Hemlock and black spruce are common, but not by any means as much so as the two species first named. Of the hemlock, many vigorous young trees were noticed, in contrast to many places farther in the interior of the state. Tamarack is occasionally found in swampy places. Of hardwoods, there are occasional specimens of the paper birch, and of three kinds of poplar, *Populus tremuloides, balsamifera* and *grandidentata.* Of underbrush there was noticed, at Egg Harbor, *Amelanchier canadensis, Ribes cynosbati, Rhus hirta, Rosa sp., Salix sp.* All of these are rather sparse; the latter was found only on the double spit projutting from the southwest side of the mouth of the bay.

Among non-arborescent species found in bloom on May 29, 1897, at Egg Harbor, I may mention: *Cypripedium pubescens,* sparingly on the ridge; *Trillium grandiflorum, Antennaria plantaginifolia, Clintonia borealis, Viola pubescens;* on the beach proper, near the spit, and growing invariably under the protection of sticks of drift wood, there was *Primula mistassinica;* in the same locality, as well as throughout the wooded portion, were many patches of some species of violet, one of those into which the old *Viola cucullata* has lately been split up. It was noticeable that all these violets were almost wholly glabrous. In the same locality, but higher up and within at least partial shade, *Iris lacustris* was copious.

The original forest on these forelands has in the neighborhood of the villages been largely removed and wide, grass-grown pastures have taken its place. On these pastures there are, at Egg Harbor, and still more conspicuously at Fish Creek, frequent clumps of *Juniperus communis var. alpina,* which is so characteristic of many places along the lake shore.

The hardwood forest of the uplands is extending its sway upon these forelands, using as channels of invasion the breaks in the cliff afforded by the fjord-valleys and an occasional smaller ravine. At the northeast side of Egg Harbor, the interval between the cliff and the water's edge is of more than ordinary breadth. Here a swamp is found between the cliff-talus and the beach-ridge. In this swamp, *Fraxinus nigra* occupies the center, being surrounded by a very dense ring of arbor vitae. A little farther up *Tilia Americana* and *Acer barbatum,* typical upland trees, make their appearance. They are accompanied by upland herbs, such as *Aralia nudicaulis.* Two herbs which are very conspicuous in the maple and beech woods of the uplands were not, at the time stated, found anywhere, either on the foreland proper, nor in this transition locality. These species are *Podophyllum peltatum* and *Anemone nemorosa.*

In conclusion, I may note that in the upland woods around Egg Harbor was found *Viola rostrata,* which I believe has not heretofore been credited to Wisconsin.

Notes on the Food of the Ruffed Grouse.

By **W. J. BENNETTS.**

Facts bearing on the relation of animals to their food supply are interesting to the student of natural history, as they assist in solving many of the problems connected with animal distribution, and help in determining the influence which a species has upon the existence of other species with which it comes in contact. The search for food is one of the principal activities in an animal's existence, occupying no inconsiderable part of its entire life, and being intimately connected with its general habits and frequently with its structure and external form. Hence investigations concerning an animal's food, generally also reveal and explain many interesting facts concerning its life history, and its morphology.

In the case of birds, the necessity for food and the habits resulting therefrom, have given rise to influences that reach out in many directions. The usual result is to reduce the number of individuals in the animal and plant world. To counteract this effect among animals, the interesting phenomena classed as mimicry and protective coloration have been evolved, while plants have accomplished the same end by greatly increasing their seed-bearing capacity and by special methods of propagation. The food habits of birds have also the opposite effect on plant life—of tending to increase the number of individuals. Fruit eating birds, for example, are agents of seed dispersion, while honey feeders are employed to effect the cross-fertilization of flowers.

The food supply of man may also be affected by birds, often prejudicially in the case of predaceous and fish or fruit-eating ones, while in the case of insectivorous and seed-eating birds the result may be beneficial.

The food habits of the species to be considered in this paper—the ruffed grouse, *Bonasa umbellus*—are especially interesting, as it is a resident or non-migratory species, and the character of its aliment must necessarily vary according to the season, and be characterized by a variety greater than is that of most migratory birds. With the latter, a radical change of diet is avoided in the fall, by joining in the southward migration, while the spring or northward migration is so timed that a species finds its customary food ready for it upon or soon after its arrival. The ruffed grouse and its allies, however, avoid a change of station by a change of food.

The geographical distribution of the typical species and its three sub-species covers the entire United States and the Dominion of Canada, with the exception of the extreme south and southwestern portions of the former and the northeastern portion of the latter, so that with so wide a range the character of the food must depend in a considerable degree upon the locality. The notes that follow apply strictly only to the northern tier of states and to southern Canada, in which localities it is known generally, though improperly, by the name of partridge.

Recently the writer, as opportunity has offered, has made examination of the stomach contents of a number of these birds, and although for lack of material, the investigation has not proceeded as far as desired, the results are presented here and supplemented with notes derived from field observation and from the published notes of others.

As is well known the ruffed grouse, like all gallinaceous birds, has its gullet or aesophagus enlarged into a preliminary stomach—the ingluvies or crop—where the food material is macerated in a special secretion before passing to the stomach proper, or gizzard. The walls of this crop are capable of very great extensibility—some of those examined containing nearly half a pint of material—and they also appear to be almost insensible to feeling so that even when distended with the sharped edged and angular beechnut or the needle like buds of certain trees, no discomfort seems to result.

For the identification of many of the seeds mentioned in the lists that follow, thanks are due to Prof. F. E. L. Beal, of the U S. Department of Agriculture. Many seeds, however, could not be identified for want of specimens for comparison.

Two ruffed grouse were collected in Washington Co., Wis., on Sept. 6, 1899. In their gizzards were found seeds of the following: (1) Wild black cherry, *Prunus serotina*; (2) one of the large cultivated Gramineae, probably *Andropogon sorgum;* (3) poison sumac, *Rhus Vernix*; (4) rough-leaved dogwood, *Cornus asperifolia;* (5) hooded blue violet, *Viola obliqua Hill.*

The crops of these birds were entirely empty. This was found to be the case with about half of the specimens handled, and the explanation probably lies in the fact that most birds feed only during the early forenoon and the late afternoon. During the middle of the day they are in their retreats, devoting that time to sleep and digestion.

Every sportsman knows that it is almost useless to look for game birds between the hours of 10 a.m. and 3 p.m., and it is likely that the owners of the empty crops were gathered in while on their way to their evening feeding grounds. No buds, leaves nor insect remains were found in these stomachs. The contents may be considered as only partly representative of the food taken during early fall, since the list given may be classified as grain, berries and the seeds of wild wood plants.

The eight birds from which the following list was obtained, were collected in Parry Sound District, Ontario, Canada, October 16, 1898. They probably, on account of the locality, belonged to the sub-species *B. u. togata,* the Canadian ruffed grouse, but opportunity was not afforded to decide the matter definitely. Although the above date is nearly a year earlier than that of the two birds previously mentioned, still as it is later in the season the specimens from Washington Co. have been considered first.

The crops of the eight birds contained the following: (1) buds of the birch tree, *Betula lutea or B. papyrifera*; (2) beech nuts, *Fagus Americana Sweet;* (3) leaves of white clover, *Trifolium repens;* (4) leaves of wood sorrel, *Oxalis Acetosella;* (5) leaves of sheep sorrel, *Rumex Acetosella L.;* (6) leaves of red raspberry, *Rubus strigosus Mx.;* (7) leaves of partridge-berry vine, *Mitchella repens;* (8) leaves of the sow-thistle, *Sonchus oleraceus L.;* (9) small mushrooms about three-quarters of an inch in diameter.

In the gizzards were found partly digested remains of most of the above and in addition many highly polished seeds or stones of the pin cherry *Prunus Pennsylvanica,* L., probably from dry berries picked from the ground, or possibly the bare seeds were mistaken for gravel of which the stomachs always contain considerable quantities. No insects, grain or seed were found. The long leaves of the sow-thistle were entire, and had been neatly rolled up or folded before swallowing.

Fourteen birds taken in Barron Co., in the northwestern part of Wisconsin, between November 10th and 20th, 1899, contributed to the list that follows: No insects were found in any of these stomachs, although those of insectivorous birds collected at the same time were full of insect remains.

The crops and stomachs contained seeds of (1) staghorn sumac, *Rhus hirta L.;* (2) white cedar or arbor vitae, *Thuja occidentalis;* (3) red mulberry, *Morus rubra;* (4) some member of the family Liliaceae; (5) hedge buckwheat *Polygonum dumetorum;* (6) partridge berry, *Mitchella repens;* (7) some species of Smilax; (8) cockspur thorn, *Crataegus Crus-Galli;* (9) of some species of the Cruciferae. They also contained catkins, both the fertile and sterile kinds, of (10) the yellow birch, *Betula lutea;* and of (11) the paper birch *B. papyrifera.* Besides the above, were leaves of (12) the northern wild strawberry *Fragaria Canadensis* Michx; and of (13) round leaved hepatica, *H. triloba.*

There were also numerous very small buds of several unknown species, and seeds of eight species that could not be identified.

Our leading writers on American ornithology have described in a general way the food of the ruffed grouse. Major Bendire, however, in his "Life Histories of N. A. Birds," has treated the subject at greater length than has any of the others, and has given a considerable list of the substances constituting its diet.

If in addition to the lists already given, we avail ourselves of those published by Major Bendire and others, as well as by the results of observations in the field, it is found that the food materials made use of by the ruffed grouse may conveniently be classified as insects, seeds, fruit, nuts, leaves and buds. Of these, insects appear to be eaten only when they are most numerous and most easily obtained, and as with most birds, they also constitute the exclusive food of the very young ones. Grasshoppers, crickets, ants, caterpillars and larvae of many kinds, and beetles are devoured in considerable quantities. *Edema albifrons,* a gregarious caterpillar injurious to oaks and maples, has been found in large numbers in their stomachs, and the writer was informed while in Parry Sound District, Ontario, in 1898, that in birds shot about midsummer, the crops are frequently distended with the tent-caterpillars that infest the wild cherry trees so common in the *burnings* of that locality.

The seeds that enter into the bill of fare of *umbellus* are those of the cultivated grains and grasses and of a number of woodland plants. Members of the violet, lily, knotgrass (*Polyganum*), and cress families have already been mentioned. To these may be added the seeds of blood-root, *Sanguinaria Canadensis;* touch-me-not, *Impatiens sp.;* and species of the genera, *Vicia* and *Lathyrus.* Seeds of several of the coniferous trees are also eaten.

Berries are a staple and favorite article of diet with the ruffed grouse and probably there are few berry-producing plants whose fruit is distasteful to him. Berries and fruit of the following have been found in their stomachs: wild black cherry, *Prunus serotina;* choke cherry, *P. Virginiana;* pin cherry, *P. Pennsylvanica;* staghorn sumac, *Rhus hirta L.;* poison sumac, *R. Vernix;* poison ivy, *R. radicans;* red osier, *Cornus stolonifera;* rough leaved dogwood, *Cornus asperifolia;* red mulberry, *Morus rubra;* partridge berry, *Mitchella repens;* several species of *Similax, Rosa,* and *Crataegus;* blackberries, raspberries, blue-berries, cranberries, huckleberries, black elder, *Sambucus Canadensis;* red elder, *S. pubens;* hobble bush, *Viburnum alnifolium*; high bush cranberry, *V. Opulus;* nanny berries,. *V. Lentago;* maple leaved viburnum, *V. acerifolium;* wintergreen, *Gaultheria procumbens*; service berry, *Amelanchier Canadensis;* and the several species of grapes and wild plums.

Considering thirty species of berries that are eaten by *B. umbellus,* we find that fifteen are red or crimson, ten blue or black, and but five white. This is about the proportion in which the colors occur in nature, the majority of fruits being red, while comparatively a few are white or green. And it is well understood that the predominence of red, not only in fruits, but in ornithophilous or bird-pollinated flowers is due to the selective preference of birds for that color. The seeds of fruits are indigestible and pass through the bird uninjured, frequently at a great distance from the parent plant. Hence those plants that cater most to the color preference of birds, in other words, whose berries are most conspicuous and attractive stand the best chance of having their seeds widely distributed, and are the most numerous in species and individuals. Certainly no more effective means for the transportation and dispersion of seeds could be devised, than that which employs birds for that purpose.

Certain of the berries mentioned, viz.: *Rhus Vernix* (poison sumac), *Rhus radicans* (poison ivy) and *Sambucus Canadensis* (red elder) are poisonous to man, but innocuous to the ruffed grouse and to many other birds. Several cases of poisoning have been reported, however, from eating the flesh of the partridge, and have been attributed to the bird's having eaten largely of these berries or of the leaves of elder or *Kalmia.*

All those nuts whose shells are thin and soft are eaten greedily by the ruffed grouse. Beechnuts, chestnuts and the acorns of the white and chestnut oaks probably complete the list.

Green leaves are eaten at all times when they can be obtained. The following may be mentioned: white clover, red clover, dandelion, chickweed, sow-thistle, peppermint, ground ivy (*Glecoma hederacea*) *Mitchella repens, Kalmia latifolia,* and *K. angustifolia.*

The buds upon which they almost entirely subsist during the wintertime are those of the three birches, the black, white and yellow; also of ironwood, poplar, the willows, wild apple, laurel (*Kalmia*) and fern. The young catkins of birch, and probably also of alder are consumed in large quantities.

Mushrooms are eaten in spring and fall, and lichens occasionally in winter.

If we next consider the food of the ruffed grouse with respect to the different seasons of the year, it will be found that in spring it consists chiefly of the young leaves of plants, of the seeds of many of the early flowers—the seed pods being swallowed entire—and of some insects, especially beetles.

During the summer the leaves of such plants as clover and sorrel still constitute a considerable portion of the food supply, but now insects, especially grasshoppers, crickets and caterpillars are consumed in large numbers and practically all the berries as they appear. The young, in the region considered, appear early in June and follow the mother at once. They are fed at first on small insects, larvae, earthworms, etc., but as they are continually picking curiously at everything they see, they quickly learn to provide for themselves and soon there is little difference between their food and that of the adults.

Seeds, fruit, nuts, buds and catkins constitute the general bill of fare during the fall months. At this time as well as through the summer, the fields of the settlers are visited for grain, and the clearings, roadways, burnings and other open places in the forest, for clover leaves, raspberries, etc., as well as for crickets and grasshoppers.

In winter their stomachs are found to contain very little except the buds of some of the trees already mentioned. They now often frequent the grassy tracts along the water courses and the frozen marsh spots in the woods in search of seeds. Lichens and dried leaves are occasionally eaten. Their flesh at this time is sometimes found to have a bitter or even turpentine taste, due probably to buds of the cedar or firs that have been eaten. Their winter habit of burrowing beneath the snow, is sometimes utilized to procure such food as nuts or leaves. Frozen fruit, like that of the high bush cranberry *(Viburnum Opulus)* is also eaten.

List of Lepidoptera of the County of Milwaukee.

By F. RAUTERBERG.

(Continued from the January Number.)

NOCTUINA.

THYATIRIDAE.

Wis. No.	Amer. No.	
		THYATIRA. *Ochs.*
221	1460	Scripta—*Gosse.* Rare.
		PSEUDOTHYATIRA. *Grt.*
222	1463 a	Expultrix—*Grt.* Common.
		LEPTINA. *Gn.*
223	1472	Ophthalmica—*Gn.* Common.
		NOCTUIDAE.
		PANTHEA. *Hbn.*
224	1474	Acronyctoides—*Walk.* Very rare.
		RAPHIA. *Hbn.*
225	1480	Abrupta—*Grt.* Common.
226	1481	Frater—*Grt.* Common.
		CHARADRA—*Walk.*
227	1483	Deridens—*Gn.* Rare.
		ARSILONCHE—*Led.*
228	1491	Albovenosa—*Goeze.* Common.
		ACRONYCTA. *Och.*
229	1494	Occidentalis. *G. & R.* Common.
230	1495	Morula—*G. & R.* Common.
231	1496	Lobeliae—*Gn.* Common.
232	1504	Betulæ—*Riley.* Rare.
233	1505	Innotata—*Gn.* Rare..
234	1517	Lepusculina—*Gn.* Common.
235	1518	Populi—*Riley.* Common.
236	1520	Americana—*Harr.* Common.
237	1521	Dactylina—*Grt.* Common.
238	1533	Brumosa—*Gn.* Rare.
239	1534	Superans—*Gn.* Rare.
240	1540	Hamamelis—*Gn.* Common.
241	1543	Retardata—*Walk.* Common.
242	1549	Lithospila—*Grt.* Rare.
243	1550	Oblinita—*S. & A.* Common.
		HARRISIMEMMA. *Grt.*
244	1558	Trisignata—*Walk.* Very rare.

Wis. No.	Amer. No.	
		MICROCOELIA. *Gn.*
245	1562	Fragilis—*Gn.* Rare.
246	1563	Diptheroides—*Gn.* Common.
		BRYOPHILA. *Tr.*
247	1564	Lepidula—*Grt.* Rare.
248	1567	Teratophora—*H-S.* Rare.
		CHYTONIX. *Grt.*
249	1573	Palliatricula—*Gn.* Rare.
		RHYNCHAGROTIS. *Smith.*
250	1575	Chardinyi—*Bdv.* Very rare.
251	1576	Rufipectus. *Morr.* Common.
252	1579	Cupida—*Grt.* Common.
253	1580	Placida—*Grt.* Common.
254	1582	Alternata—*Grt.* Common.
		ADELPHAGROTIS. *Smith.*
255	1603	Prasina—*Fabr.* Common.
		PLATAGROTIS. *Smith.*
256	1608	Pressa. *Grt.* Rare.
		EUERETAGROTIS. *Smith.*
257	1612	Sigmoides—*Gn.* Common.
258	1613	Perattenta—*Grt.* Rare.
		AGROTIS. *Tr.*
259	1629	Badinodis—*Grt.* Rare.
260	1632	Ypsilon—*Rott.* Very common.
		PERIDROMA. *Hbn.*
261	1655	Occulta—*Linn.* Rare.
262	1659	Saucia—*Hbn.* Very common.
		NOCTUA—*Linn.*
263	1666	Baja—*Fabr.* Rare.
264	1667	Normaniana—*Grt.* Common.
265	1669	Bicarnea—*Gn.* Common.
266	1672	C-Nigrum—*Linn.* Common.
267	1676	Phyllophora—*Grt.* Rare.
268	1681	Fennica—*Tausch.* Common.
269	1682	Plecta—*Linn.* Common.
270	1683	Collaris—*G & R.* Common.
271	1684	Haruspica—*Grt.* Common.
272	1687	Clandestina—*Harr.* Common.
		RHIZAGROTIS. *Smith.*
273	1708	Apicalis—*Grt.* Rare.
		FELTIA—*Walk.*
274	1713	Subgothica—*Steph.* Common.
275	1714	Jaculifera—*Gn.* Common.
276	1715	Herilis—*Grt.* Common.
277	1719	Gladiaria—*Morr.* Common.
278	1720	Venerabilis—*Walk.* Common.
279	1722	Vancouverensis--*Grt.* Common.
280	1724	Volubilis—*Grt.* Common.
281	1725	Annexa—*Tr.* Common.
		POROSAGROTIS. *Smith.*
282	1727	Muraenula—*G. & R.* Common.
283	1728	Catenula—*Grt.* Common.
284	1731	Mimallonis—*Grt.* Common.
285	1733	Worthingtoni—*Grt.* Common.
286	1734	Rileyana—*Morr.* Common.

Wis. No.	Amer. No.	
		CARNEADES. *Grt.*
287	1746	Quadridentata—*G. & R.* Common.
288	1749	Brevipennis—*Smith.* Rare.
289	1777	Scandens—*Riley.* Rare.
290	1781	Pitychrous.—*Grt.* Rare.
291	1795	Messoria—*Harr.* Rare.
292	1825 a	Verticalis—*Grt.* Common.
293	1827	Tessellata—*Harr.* Common.
294	1844	Redimicula—*Morr.* Common.
		ANYTUS. *Grt.*
295	1854	Sculptus—*Grt.* Common.
		MAMESTRA. *Ochs.*
296	1876	Discalis--*Grt.* Rare.
297	1878	Nimbosa—*Gn.* Rare.
298	1879	Imbrifera—*Gn.* Rare.
299	1886	Lustralis—*Grt.* Common.
300	1903	Trifolii—*Rott.* Rare.
301	1905	Rosea—*Harr.* Rare.
302	1908	Picta—*Harr.* Common.
303	1910	Cristifera—*Walk.* Common.
304	1912	Latex—*Gn.* Rare.
305	1924	Lilacina—*Harv.* Rare.
306	1929	Obscura—*Smith.* Common.
307	1931	Renigera—*Steph.* Common.
308	1934	Circumcincta—*Smith.* Rare.
309	1935	Olivacea—*Morr.* Common.
310	1944	Lorea--*Gn.* Common.
311	1950	Vicina—*Grt.* Rare.
		HADENA. *Schrank.*
312	1979	Niveivenosa—*Grt.* Rare.
313	1980	Stipata—*Morr.* Rare.
314	1981	Passer—*Gn.* Common.
315	1985 [2]	*Suffusca—Morr.* Rare.
316	1990	Finitima—*Gn.* Rare.
317	1994	Sputatrix—*Grt.* Common.
318	1998	Impulsa—*Gn.* Common.
319	1999	Devastatrix—*Brace.* Rare.
320	2002	Arctica—*Bdv.* Very common.
321	2006	Perpensa—*Grt.* Common.
322	2007	Cuculliformis—*Grt.* Common.
323	2009	Verbasroides.—*Gn.* Common.
324	2011	Cariosa—*Gn.* Rare.
325	2014	Vulgaris—*G. & R.* Rare.
326	2020	Lignicolor—*Gn.* Common.
327	2036	Modica—*Gn.* Common.
328	2044	Mactata—*Grt.* Rare.
329	2060	Vulvivaga—*Morr.* Common.
330	2060 a	Fractilinea—*Grt.* Rare.
		TRACHEA. *Hrn.*
331	2075	Delicata—*Grt.* Common.
		OLIGIA. *Hbn.*
332	2083	Versicolor—*Grt.* Very rare.
		PERIGEA. *Gn.*
333	2100	Fasciata—*Hy. Edw.* Rare.
		DIPTERYGIA. *Steph.*
334	2110	Scabriuscula—*Linn.* Rare.

Wis. No.	Amer. No.	
		HYPPA. *Dup.*
335	2111	Xylinoides—*Gn.* Common.
		HOMOHADENA. *Grt.*
336	2127	Badistriga—*Grt.* Rare.
		MACRONOCTUA. *Grt.*
337	2162	Onusta—*Grt.* Common.
		POLIA. *Tr.*
338	2181	Medialis—*Grt.* Rare.
		ACTINOTIA. *Hbn.* Very rare.
339	2184	Ramosula—*Gn.*
		LAPHYGMA. *Gn.*
340	2187 a	Obscura—*Riley.* Common.
		PRODENIA. *Gn.*
341	2189	Lineatella—*Harv.* Common.
342	2190	Flavimedia—*Harv.* Rare.
343	2194	Ornithogalli—*Gn.* Rare.
344	2195	Signifera—*Walk.* Common.
		TRIGONOPHORA. *Hbn.*
345	2198	Periculosa—*Gn.* Common.
		BROTOLOMIA. *Led.*
346	2199	Iris—*Gn.* Common.
		NEPHELODES. *Gn.*
347	2201	Minians—*Gn.* Common.
348	2201 a	Violans—*Gn.* Common.
		TRICHOLITA. *Grt.*
349	2202	Signata—*Walk.* Rare.
		HELOTROPHA. *Leb.*
350	2206	Reniformis—*Grt.* Rare.
		HYDROECIA. *Gn.*
351	2209	Velata—*Walk.* Rare.
352	2209[1]	*Sera—G. & R.* Common.
353	2211	Nictitans—*Bkh.* Rare.
354	2211 a	Erythrostigma—*Harv.* Rare.
355	2220	Cataphracta—*Grt.* Common.
356	2221	Purpurifascia—*G. & R.* Rare.
357	2222	Rutila—*Gn.* Rare.
358	2224	Speciosissima—*G. & R.* Rare.
359	2225	Marginidens—*Gn.* Rare.
360	2229	Nitela—*Gn.* Common.
361	2229 a	Nebris—*Gn.* Common.
		ACHATODES. *Gn.*
362	2235	Zeæ—*Harr.* Common.
		ARZAMA. *Walk.*
363	2238	Obliquata—*G. & R.* Rare.
364	2240	Vulnifica—*Grt.* Very rare.
365	2241	Diffusa—*Grt.* Rare.
		NONAGRIA. *Ochs.*
366	2242	Permagna—*Grt.* Common.
367	2249	Subcarnea—*Kell.* Common.
		LEUCANIA. *Ochs.*
368	2258	Pallens—*Linn.* Common.
369	2264	Rubripennis—*G. & R.* Very rare.
370	2266	Albilinea—*Hbn.* Common.
371	2271	Phragmatidicola—*Gn.* Rare.
372	2274	Adonea—*Grt.* Common.
373	2275	Commoides—*Gn.* Common.

Wis. No.	Amer. No.	
374	2280	Unipuncta--*Harv.* Common.
375	2283	Pseudargyria—*Gn.* Common.
		AMOLITA. *Grt.*
376	2301	Fessa. *Grt.* Common.
		NOLOPHANA. *Grt.*
377	2303	Malana—*Fitch.* Rare.
		CRAMBODES. *Gn.*
378	2310	Talidiformis—*Gn.* Common.
		CARADRINA. *Tr.*
379	2313	Miranda—*Grt.* Common.
		PYROPHILA. *Hbn.*
380	2327	Pyramidoides—*Gn.* Very common.
		ORTHODES. *Gn.*
381	2329	Infirma—*Gn.* Rare.
382	2330	Cynica—*Gn.* Common.
		TAENIOCAMPA. *Gn.*
383	2340	Peredia—*Grt.* Common.
384	2364	Subterminata—*Smith.* Common.
385	2369	Vegeta—*Morr.* Rare.
386	2372[2]	Planalis—*Grt.* Very rare.
		STRETCHIA. *Hy. Edw.*
387	2375	Plusiiformis—*Hy. Edw.* Rare.
		PSEUDOGLÆA. *Grt.*
388	2392	Tædata—*Grt.* Rare.
		TRILEUCA. *Grt.*
389	2401	Buxea—*Grt.* Very rare.
		CALYMNIA. *Hbn.*
390	2405	Orina—*Gn.* Common.
		COSMIA—*Ochs.*
391	2411	Paleacea—*Esp.* Common.
		PARASTICHTIS. *Hbn.*
392	2414	Discivaria—*Walk.* Rare.
393	2414[1]	*Gentilis—Grt.* Rare.
		IPIMORPHA. *Hbn.*
394	2415	Pleonectusa—*Grt.* Common.
		ANCHOCELIS. *Gn.*
395	2418	Digitalis—*Grt.* Rare.
		PYRRHIA. *Hbn.*
396	2419	Umbra—*Hbn.* Common.
397	2419 a	Angulata—*Grt.* Common.
		ORTHOSIA. *Ochs.*
398	2425	Ferruginoides—*Gn.* Common.
399	2434	Helva—*Grt.* Common.
400	2435	Lutosa—*Andr.* Common.
		HOMOGLÆA. *Morr.*
401	2442	Hircina—*Morr.* Rare.
		GLÆA. *Hbn.*
402	2445	Inulta -*Grt.* Common.
		XANTHIA. *Tr.*
403	2456	Flavago—*Fabr.* Common.
		JODIA. *Hbn.*
404	2459	Rufago—*Hbn.* Common.
		CIRROEDIA. *Gn.*
405	2460	Pampina--*Gn.* Rare.
		SCOLIOPTERYX. *Germ.*
406	2462	Libatrix—*Linn.* Common.

Wis. No.	Amer. No.	
		SCOPELOSOMA. *Curtis.*
407	2463	Græfiana—*Grt.* Very common.
408	2470	Morrisoni—*Grt.* Common.
409	2471	Devia—*Grt.* Common.
		XYLINA. *Ochs.*
410	2479	Bethunei—*G. & R.* Rare.
411	2483	Fagina—*Morr.* . Rare.
412	2486	Antennata—*Walk.* Rare.
413	2487	Laticinerea—*Grt.* Rare.
414	2488	Grotei—*Riley.* Rare.
		XYLOMIGES. *Gn.*
415	2516	Crucialis—*Harr.* Rare.
		LITHOMIA. *Hbn.*
416	2524	Germana—*Morr.* Rare.
		CALOCAMPA. *Steph.*
417	2527	Cineritia—*Grt.* Rare.
		CUCULLIA. *Schrank.*
418	2532	Convexipennis—*Grt.* Rare.
419	2536	Asteroides—*Gn.* Common.
		ALETIA. *Hbn.*
420	2563	Argillacea—*Hbn.* Common.
		OGDOCONTA. *Butl.*
421	2570	Cinereola. *Gn.* Rare.
		ABROSTOLA. *Ochs.*
422	2574	Urentis—*Gn.* Rare.
		PLUSIA. *Fabr.*
423	2578	Aerea. *Hbn.* Common.
424	2579	Aereoides—*Grt.* Rare.
425	2580	Balluca—*Geyer.* Common.
426	2583	Contexta—*Grt.* Common.
427	2584	Putnami—*Grt.* Rare.
428	2587	Thyatiroides. *Gn.* Rare.
429	2590	Biloba—*Steph.* Rare.
430	2591	Verruca—*Farr.* Rare.
431	2592	Dyaus—*Grt.* Common.
432	2594	Precationis—*Gn.* Common.
433	2600	Ou—*Gn.* Rare.
434	2603	Brassicæ--*Riley.* Common.
435	2604	Oxygramma—*Geyer.* Rare.
436	2608	Mortuorum—*Gn.* Very rare.
437	2611	Viridisignata—*Grt.* Rare.
438	2616	Ampla—*Walk.* Very rare.
439	2617	Simplex—*Gn.* Very common.
		HELIOTHIS—*Hbn.*
440	2691	Rhexia—*S. & A.* Rare.
441	2694	Armiger—*Hbn.* Very common.
442	2694 a	Umbrosus. *Grt.* Very common.
443	2695	Dipsaceus—*Linn.* Rare.
444	2695 a	Maritima—*Grasl.* Very rare.
445	2696	Scutosus—*Fabr.* Rare.
		RHODODIPSA. *Grt.*
446	2706	Miniana—*Grt.* Rare.
		SCHINIA. *Hbn.*
447	2717	Trifascia—*Hbn.* Common.
448	2718	Gracilenta—*Hbn.* Rare.

Wis. No.	Amer. No.	
449	2724	Nundina—*Dru.* Rare.
450	2734	Tertia—*Grt.* Common.
451	2738	Gloriosa—*Strk.* Very rare.
452	2751	Rivulosa—*Gn.* Common.
453	2752	Digitalis—*Smith.* Rare.
454	2755 a	Atrites—*Grt.* Very rare.
		ACONTIA. *Ochs.*
455	2840	Erastrioides—*Gn.* Common.
456	2841	Candefacta—*Hbn.* Common.
		CHAMYRIS. *Gn.*
457	2852	Cerintha—*Tr.* Rare.
458	2852[1] var.	Cerintha—*Tr.* Rare.
		XANTHOPTERA. *Gn.*
459	2863	Nigrofimbria—*Gn.* Rare.
		METATHORASA. *Moore.*
460	2889	Monetifera—*Gn.* Rare.
		EUHERRICHIA. *Grt.*
461	2890	Mollissima—*Gn.* Rare.
		ERASTRIA. *Ochs.*
462	2899	Albidula—*Gn.* Common.
463	2902	Concinnimacula—*Gn.* Very rare.
464	2903	Synochitis—*G. & R.* Very rare.
465	2906	Muscosula—*Gn.* Common.
466	2911	Apicosa—*Harv.* Common.
467	2912	Carneola—*Gn.* Very common.
		GALGULA. *Gn.*
468	2925	Hepara—*Grt.* Common
469	2926	Subpartita—*Gn.* Rare.
		HYBLÆA. *Fabr.*
470	2938	Puera—*Fabr.* Rare.
471	2938 var.	Puera—*Fabr.* Common.
		DRASTERIA. *Hbn.*
472	2939	Erechtea—*Cram.* Common
473	2939 a	Agricola—*G. & R.* Common.
474	2940	Erichto—*Gn.* Common.
		EUCLIDIA—*Hbn.*
475	2946	Cuspidea—*Hbn.* Common.
		SYNEDA—*Gn.*
476	2969	Graphica--*Hbn.* Common.
477	2981	Nubicola—*Behr.* Rare.
		CIRRHOBOLINA. *Grt.*
478	2992	Mexicana—*Behr.* Rare.
		MELIPOTIS. *Hbn.*
479	2998	Nigrescens—*G. & R.* Rare.
480	3001	Limbolaris--*Geyer.* Very rare.
		STICTOPTERA. *Gn.*
481	3007	Divaricata--*Grt.* Rare.
		CATOCALA. *Schrank.*
482	3008	Nubilis—*Hbn.* Common.
483	3011	Amica—*Hbn.* Rare.
484	3011 a	Lineella--*Grt.* Common.
485	3015	Grynea—*Cram.* Common.
486	3024	Blandula—*Hulst.* Rare.
487	3027	Nuptialis--*Walk.* Common.
488	3035	Cerogama—*Gn.* Common.
489	3037 a	Celia--*Hy. Edw.* Rare.

Wis. No.	Amer. No.	
490	3039 a	Uxor—*Gn.* Common.
491	3041	Marmorata—*Edw.* Common.
492	3042	Parta—*Gn.* Common.
493	3042 a	Petulans—*Hulst.* Common.
494	3043	Unijuga—*Walk.* Common.
495	3043 a	Meskei—*Grt.* Rare.
496	3048	Mariana—*Hy. Edw.* Rare.
497	3049	Briseis—*Edw.* Common.
498	3053	Concumbens—*Walk.* Common.
499	3054	Cara—*Gn.* Common.
500	3054 a	Carissima—*Hulst.* Common.
501	3058	Relicta—*Walk.* Common.
502	3058 a	Phrynia—*Hy. Edw.* Rare.
503	3058 b	Bianca—*Hy. Edw.* Rare.
504	3063	Serena—*Edw.* Common.
505	3066	Habilis—*Grt.* Common.
506	3068	Paleogama—*Gn.* Rare.
507	3083	Insolabalis—*Gn.* Rare.
508	3085	Obscura—*Strk.* Common.
509	3085 a	Residua—*Grt.* Rare.
		PARALLELIA *Hbn.*
510	3101	Bistriaris—*Hbn.* Rare.
		PANAPODA. *Gn.*
511	3105 b	Roseicosta—*Gn.* Rare.
		POAPHILA. *Gn.*
512	3116	Quadrifilaris—*Hbn.* Rare.
		EREBUS. *Latr.*
513	3150	Odora—*Linn.* Very rare.
		THYSANIA. *Dalm.*
514	3151	Zenobia—*Cram.* Very rare.
		HOMOPTERA. *Bdv.*
515	3158	Edusa—*Dru.* Very Common.
516	3158 a	Saundersii—*Beth.* Very common.
517	3158 b	Lunata—*Dru.* Very common.
		HOMOPYRALIS. *Grt.*
518	3197	Tactus—*Grt.* Rare.
		SPARGALOMA. *Grt.*
519	3204	Sexpunctata—*Grt.* Rare.
		PSEUDAGLOSSA. *Grt.*
520	3211	Lubricalis—*Geyer.* Rare.
521	3214	Borealis—*Smith.* Common.
		EPIZEUXIS. *Hbn.*
522	3215	Aemula—*Hbn.* Common.
523	3216	Americalis—*Gn.* Common.
		LITOGNATHA. *Grt.*
524	3225	Nubilifascia—*Grt.* Common.
		HERMINIA. *Latr.*
525	3228	Morbidalis—*Gn.* Common.
526	3229	Petrealis—*Grt.* Common.
		ZANCLOGNATHA. *Led.*
527	3238	Ochreipennis—*Grt.* Common.
		PHILOMETRA. *Grt.*
528	3246	Longilabris—*Grt.* Common.
529	3247	Eumelusalis—*Walk.* Common.
530	3247 [1]	*Serraticornis*—*Grt.* Common.

Wis. No.	Amer. No.	
		RIVULA. *Gn.*
531	3250	Propinqualis—*Gn.* Common.
		PALTHIS. *Hbn.*
532	3252	Angulalis—*Hbn.* Common.
		HETEROGRAMMA. *Gn.*
533	3254	Rurigena—*Grt.* Common.
		RENIA. *Gn.*
534	3266	Flavipunctalis—*Geyer.* Common.
		BLEPTINA. *Gn.*
535	3273	Caradrinalis—*Gn.* Common.
		LOMANALTES. *Grt.*
536	3277	Laetulus—*Grt.* Common.
		BOMOLOCHA. *Led.*
537	3278	Baltimoralis—*Gn.* Rare.
538	3279	Scutellaris—*Grt.* Very rare.
539	3281	Bijugalis—*Walk.* Rare.
540	3283	Abalinealis—*Walk.* Rare.
541	3291	Sordidula—*Grt.* Rare.
542	3294	Perangulalis—*Harr.* Common.
		HYPENA. *Fabr.*
543	3297	Humuli—*Harr.* Rare.
544	3300	Scabra—*Fabr.* Very common.
		TORTRICODES. *Gn.*
545	3313	Bifidalis—*Grt.* Common.

GEOMETRINA.

GEOMETRIDAE.

ENNOMINÆ.

		PROCHOERODES. *Grt.*
546	3325	Clemataria—*S. & A.* Common.
547	3326	Transversata—*Dru.* Common.
		TETRACIS. *Gn.*
548	3349	Lorata—*Grt.* Common.
549	3350	Crocallata—*Gn.* Common.
		METANEMA. *Gn.*
550	3352	Quercivoraria—*Gn.* Common.
551	3355	Inatomaria—*Gn.* Common.
552	3356	Carnaria—*Pack.* Common.
		CABERODES. *Gn.*
553	3365	Confusaria—*Hbn.* Common.
554	3365 a	Metrocamparia—*Gn.* Common.
		ENNOMOS. *Tr.*
555	3373	Magnarius—*Gn.* Rare.
556	3374	Subsignarius—*Hbn.*
		ENDROPIA. *Gn.*
557	3382	Serrata—*Dru.* Rare.
558	3386	Bilinearia—*Pack.* Rare.
559	3388	Armataria—*H-S.* Rare.
560	3391	Madusaria—*Walk.* Common.
561	3394	Pectinaria—*Schif.* Rare.
562	3399	Hypochraria—*H-S.* Rare.
563	3400	Duaria—*Gn.* Common.

Wis. No.	Amer. No.	
		THERINA. *Hbn.*
564	3410	Pellucidaria—*G. & R.* Common.
		METROCAMPA. *Latr.*
565	3415	Margaritata—*L.* Common.
566	3415 a	Perlata—*Gn.*
		ANGERONA. *Dup.*
567	3429	Crocataria—*Fabr.* Very common.
		MICROGONIA. *H-S.*
568	3431	Limbaria—*Haw.* Common.
		PLAGODIS. *Hbn.*
569	3432	Serinaria—*H-S.* Very rare.
570	3433	Keutzingaria—*Pack.* Very rare.
571	3437	Alcoolaria—*Gn.* Common.
		PROBOLE. *H-S.*
572	3438	Amicaria—*H-S.* Common.
573	3438[1]	*Nyssaria—Gn.* Common.
		APLODES. *Gn.*
574	3451	Mimosaria—*Gn.* Rare.
		NEMORIA. *Hbn.*
575	3470	Subcroceata—*Walk.* Common.
576	3471	Gratata—*Pack.* Rare.
577	3472	Pistaceata—*Gn.* Rare.
		DYSPTERIS. *H-S.*
578	3485	Abortivaria—*H-S.* Very rare.
		EPHYRA. *Dup.*
579	3487	Pendulinearia—*Gn.* Common.
		ACIDALIA. *Tr.*
580	3505	Insularia—*Gn.* Common.
581	3509	Nivosata—*Gn.* Common.
582	3512	Inductata—*Gn.* Common.
583	3522	Quadrilineata—*Pack.* Common.
584	3524	Ennucleata—*Gn.* Common.
585	3524 (var)	Ennucleata—*Gn.* Rare.
586	3562[1]	Umbilicuta—*Gn.* Rare.
		ASTHENA. *Hbn.*
587	3563	Lucata—*Gn.* Rare.
588	3564	Albogilvaria—*Morr.* Very common.
		CALLEDAPTERYX. *Grt.*
589	3584	Dryopterata—*Grt.* Very rare.
		CABERINAE.
		STEGANIA. *Dup.*
590	3587	Pustularia—*Gn.* Rare.
		GUENERIA. *Pack.*
591	3589	Basiata—*Walk.* Common.
		DEILINIA. *Hbn.*
592	3590	Variolaria—*Gn.* Common.
593	3594[1]	*Septemfluaria—Grt.* Common.
		CORYCIA. *Dup.*
594	3596	Vestaliata—*Gn.* Common.
		SEMIOTHISA. *Hbn.*
595	3603	Præatomata—*Harv.* Rare.
596	3606	Multilineata—*Pack.* Rare.
597	3614	Ocellinata—*Gn.* Common.
598	3614 (var)	Ocellinata—*Gn.* Rare.
599	3618	Respersata—*Hulst.* Rare.

Wis. No.	Amer. No.	
		PHASIANE. *Dup.*
600	3642	Curvata—*Grt.* Rare.
601	3643	Mellistrigata—*Grt.* Common.
602	3656 [1]	Evagaria—*Hulst.* Common.
		MARMOPTERYX. *Pack.*
603	3661	Formosata—*Strk.* Common.
		THAMNONOMA. *Led.*
604	3670	Subcessaria—*Walk.* Common.
605	3674½	Wagaria—*Hulst.* Rare.
		EUFITCHIA. *Pack.*
606	3679	Ribearia—*Fabr.* Common.
		LOZOGRAMMA. *Steph.*
607	3680	Disconventa—*Walk.* Common.
608	3684	Defluata—*Walk.* Rare.
		ORTHOFIDONIA. *Pack.*
609	3692	Exornata—*Walk.* Rare.
		LYTHRIA. *Hbn.*
610	3709	Chamæchrysaria-*Grt.* Very common.
		CATERVA. *Grt.*
611	3712	Catenaria—*Cram.* Common.
		ASPILATES. *Tr.*
612	3737	Desperaria—*Hulst.* Very rare.
		BOARMINAE.
		CLEORA. *Steph.*
613	3748	Semiclusaria—*Walk.* Common.
		BOARMIA. *Tr.*
614	3769	Pampinaria—*Gn.* Common.
615	3771	Larvaria—*Gn.* Rare.
616	3772	Humaria—*Gn.* Rare.
617	3776	Crepuscularia—*Tr.* Common.
		TEPHROSIA. *Bdv.*
618	3795	Canadaria—*Gn.* Common.
619	3799	Anticaria—*Walk.* Rare.
		PARAPHIA. *Gn.*
620	3806	Subatomaria—*Grt.* Rare.
		BISTON. *Leach.*
621	3810	Ursarius—*Walk.* Rare.
		EUBYIA. *Hbn.*
622	3812	Cognataria—*Gn.* Common.
623	3814	Quernaria—*S. & A.* Rare.
624	3815	Mexicanaria—*Grt.* Rare.
		HYBERNIA. *Latr.*
625	3817	Tiliaria—*Harr.* Very common.
		PALEACRITA. *Riley.*
626	3823	Vernata—*Pack.* Very common.
		ANISOPTERYX. *Steph.*
627	3824	Pometaria—*Harr.* Common.
		HETEROPHLEPS. *H-S.*
628	3829	Triguttata—*H—S.* Common.
629	3830	Harveiata—*Pack.* Rare.
		BAPTRIA. *Hbn.*
630	3835	Albovittata—*Gn.* Common.
		LOBOPHORA. *Curt.*
631	3842	Montanata—*Pack.* Rare.

Wis. No.	Amer. No.	
		TRIPHOSA. *Steph.*
632	3846	Dubitata—*Linn.* Common.
		CALOCALPE. *Hbn.*
633	3854	Undulata—*Linn.* Rare.
		PHIBALAPTERYX. *Steph.*
634	3855	Latirupta—*Walk.* Common.
635	3856	Intestinata—*Gn.* Common.
		PETROPHORA. *Hbn.*
636	3859	Testata—*L.* Very rare.
637	3861	Prunata—*L.* Very rare.
638	3865	Diversilineata—*Hbn.* Common.
639	3871	Hersiliata—*Gn.* Rare.
		RHEUMAPTERA. *Hbn.*
640	3892	Ruficillata—*Gn.* Common.
641	3897	Lacustrata—*Gn.* Common.
642	3899	Sociata—*Bork.* Common.
643	3902	Hastata—*L.* Rare.
		OCHYRIA. *Hbn.*
644	3909	Ferrugata—*Linn.* Common.
645	3911	Designata—*Hbn.* Common.
		HYDRIOMENE. *Hbn.*
646	3923	Trifasciata—*Bork.* Rare.
		EPIRRITA. *Hbn.*
647	3929	Inclinata—*Walk.* Rare.
		PLEMYRIA. *Hbn.*
648	3934	Fluviata—*Hbn.* Very common.
		GLAUCOPTERYX. *Hbn.*
649	3941	Aurata—*Grt.* Rare.
650	3943	Implicata—*Gn.* Rare.
		EUPITHECIA. *Curt.*
651	3959	Implicata—*Walk.* Very rare.
652	3961	Absynthiata—*L.* Common.
		NEOTERPES.
653	3969^3	Edwarssetta—*Pack.* Very rare.

PYRALIDINA.

PYRAUSTIDAE.

Wis. No.	Amer. No.	
		MARGARONIA. *Hbn.*
654	3972	Quadristigmalis—*Gn.* Common.
		EPICORSIA. *Hbn.*
655	3977	Mellinalis—*Hbn.* Rare.
		DIATHRAUSTA. *Led.*
656	3985	Pisusalis —*Walk.* Rare.
		DESMIA. *Westw.*
657	3986	Funeralis—*Hbn.* Common.
658	3986^1	*Maculalis—Westw.* Rare.
		PILOCROCIS. *Led.*
659	3987	Ramentalis—*Led.* Rare.
		CINDAPHIA. *Led.*
660	3990	Bicoloralis—*Gn.* Common.
		PHLYCTÆNIA. *Hbn.*
661	3992	Acutella—*Walk.* Common.
662	3993	Ferrugalis—*Hbn.* Common.

Wis. No.	Amer. No.	
663	3995	Terrealis—*Tr.* Common.
664	3996	Extricalis—*Gn.* Common.
665	3997	Tertialis—*Gn.* Common.
		NOMOPHILA. *Hbn.*
666	3998	Noctuella—*S. V.* Common.
		PYRAUSTA. *Schrank.*
667	4000	Octomaculata—*Linn.* Common.
668	4004	Orphisalis—*Walk.* Common.
669	4010	Signatalis—*Walk.* Common.
670	4036	Unifascialis—*Pack.* Common.
671	4039	Tatalis—*Grt.* Rare.
672	4040	Fumalis—*Gn.* Rare.
673	4042	Fodinalis—*Led.* Rare.
674	4042[1]	*Socialis—Grt.* Common.
675	4043	Penitalis—*Grt.* Common.
676	4048	Illibalis—*Hbn.* Rare.
677	4053	Futilalis—*Led.* Very rare.
678	4055	Detritalis—*Gn.* Very rare.
679	4067	Thestialis—*Walk.* Common.
680	4069	Ranalis—*Gn.* Common.
681	4071	Pertextalis—*Led.* Common.
682	4073	Theseusalis—*Walk.* Rare.
		MECYNA. *Gn.*
683	4081	~~Reversalis~~—*Gn.* Rare.
		PANTOGRAPHA. *Led.*
684	4082	Limata—*G. & R.* Rare.
		CROCIDOPHORA. *Led.*
685	4088	Serratissimalis—*Zell.* Common.
686	4089	Tuberculalis—*Led.* Rare.
		LOXOSTEGE. *Hbn.*
687	4095	Chortalis—*Grt.* Rare.
688	4099	Coloradensis—*G. & R.* Rare.
689	4104	Obliteralis—*Walk.* Common.
690	4111	Sticticalis—*Linn.* Common.
		SCOPARIA. *Haw.*
691	4127	Centuriella—*S. V.* Common.
692	4128	Libella—*Grt.* Common.
		EVERGESTIS. *Hbn.*
693	4132	Straminalis—*Zell.* Common.
694	4132 (var)	*Stramentalis—Hbn.*
		CATACLYSTA. *Hbn.* Common.
695	4155	Fulicalis—*Clem.* Very common.
696	4156	Bifascialis—*Rob.* Very common.
		HYDROCAMPA. *Latr.*
697	4167	Obliteralis—*Walk.* Common.
698	4169	Obscuralis—*Grt.* Common.
699	4170	Albalis—*Rob.* Common.
700	4171	Allionealis—*Walk.* Common.
701	4172	Gyralis—*Hulst.* Rare.
702	4174	Icciusalis—*Walk.* Common.
703	4175	Ekthlipsis—*Grt.* Common.
		SCHOENOBIUS. *Dup.*
704	4178	Unipunctellus—*Rob.* Rare.
705	4180	Melinellus—*Clem.* Rare.
706	4180 b	Albicostellus—*Fern.* Common.

Wis. No.	Amer. No.	
707	4181	Clemensellus—*Rob.* Common.
708	4182	Forficellus—*Thunb.* Common.
		NYMPHÆELLA. *Grt.*
709	4185	Maculalis—*Clem.* Rare.

PYRALIDIDAE.

PYRALIDINAE.

		PYRALIS. *Linn.*
710	4202	Farinalis—*Linn.* Very common.
711	4203	Costalis—*Fabr.* Common.
712	4203[1]	*Fimbrialis—S. V.* Common.
713	4205	Olinalis—*Gn.* Common.
714	4206	Himonialis—*Zell.* Common.
715	4210	Sodalis—*Walk.* Rare.

EPIPASCHIINAE.

		EPIPASCHIA. *Clem.*
716	4216	Superatalis—*Clem.* Rare.
		BENTA. *Walk.*
717	4227	Asperatella—*Clem.* Rare.

PHYCITIDAE.

PHYCITINAE.

		ACROBASIS. *Zell.*
718	4263	Rubrifasciella—*Pack.* Common.
719	4271	Hebescella—*Hulst.* Rare.
		MEROPTERA. *Grt.*
720	4317	Pravella—*Grt.* Common.
		SALEBRIA. *Zell.*
721	4329	Lævigaetella—*Hulst.* Common.
		LAODAMIA. *Rag.*
722	4338	Fusca—*Haw.* Common.
		LÆTILIA. *Rag.*
723	4388	Coccidivora—*Comst.* Rare.
		HONORA. *Grt.*
724	4392 a	Undulatella—*Clem.* Rare.
		HOMŒOSOMA. *Curt.*
725	4408	Electellum—*Hulst.* Rare.

PEORIINAE.

		ALTOONA. *Hulst.*
726	4437	Tetradella—*Zell.* Rare.
		PEORIA. *Rag.*
727	4451	HÆMATICA. *Zell.* Common.

CRAMBIDAE.

		ARGYRIA. *Hbn.*
728	4476	Nivalis—*Dru.* Common.
729	4478	Auratella—*Clem.* Common.
		DIATRÆA. *Guild.*
730	4481	Saccharalis—*Farr.* Rare.

Wis. No.	Amer. No.	
		CRAMBUS. *Fabr.*
731	4490	Hastiferellus—*Walk.* Common.
732	4494	Hamellus—*Thunb.* Common.
733	4497	Leachellus—*Zinck.* Common.
734	4498	Unistriatellus—*Pack.* Common.
735	4499	Prætectellus—*Zinck.* Rare.
736	4505	Laqueatellus—*Clem.* Common.
737	4507	Agitatellus—*Clem.* Very common.
738	4507 a	Alboclavellus—*Zell.* Very common.
739	4511	Albellus—*Clem.* Very common.
740	4513	Girardellus—*Clem.* Common.
741	4514	Innotatellus—*Walk.* Common.
742	4523	Ruricolellus—*Zell.* Very common.
743	4524	Vulgivagellus—*Clem.* Very common.
744	4533	Caliginosellus—*Clem.* Rare.
745	4536	Inornatellus—*Walk.* Rare.
746	4537	Mutabilis—*Clem.* Very common.
		THAUMATOPSIS. *Morr.*
747	4540	Pexellus—*Zell.* Common.

PTEROPHORIDAE.

Wis. No.	Amer. No.	
		PLATYPTILIA—*Hbn.*
748	4556	Fragilis—*Wlsm.* Common.
		ALUCITA. *Linn.*
749	4578	Homodactyla—*Walk.* Common.
750	4581	Paleacea—*Zell.* Common.
		OXYPTILUS—*Zell.*
751	4594	Periscelidactylus—*Fitch.* Common.
752	4597	Tenuidactylus—*Fitch.* Rare.

TORTRICINA.

TORTRICIDAE.

Wis. No.	Amer. No.	
		TERAS. *Tr.*
753	4616	Hastiana—*Linn.* Common.
754	4619	Logiana—*Schif.* Common.
		CACOECIA—*Hbn.*
755	4633	Rosaceana—*Harr.* Common.
756	4634	Purpurana—*Clem.* Common.
757	4634 a	Lintneriana—*Grt.* Common.
758	4642	Argyrospila—*Walk.* Rare.
759	4644	Fervidana—*Clem.* Common.
		LOXOTAENIA—*Steph.*
760	4650	Virescana—*Clem.* Common.
761	4651	Clemensiana—*Fern.* Common.
		PTYCHOLOMA. *Steph.*
762	4653	Melaleucana—*Walk.* Common.
		TORTRIX—*Linn.*
763	4684	Fucana—*Wlsm.* Common.
		CENOPIS. *Zell.*
764	4705	Reticulatana—*Clem.* Common.
765	4706	Pettitana—*Rob.* Rare.
		DICHELIA. *Gn.*
766	4713	Sulfureana—*Clem.* Rare.

Wis. No.	Amer. No.	
		AMPHISA. *Curt.*
767	4717	Discopunctana—*Clem.* Very rare.
		GRAPHOLITHIDAE.
		EXARTEMA. *Clem.*
768	4789	Permundana—*Clem.* Common.
769	4794	Fasciatana—*Clem*, Common.
770	4796	Exoleta—*Zell.* Common.
		PENTHINA. *Tr.*
771	4804	Nimbatana—*Clem.* Common.
772	4807	Dimidiana—*Schif.* Common.
773	4821	Chionosema—*Zell.* Common.
		SERICORIS. *Tr.*
774	4828	Coruscana—*Clem.* Very common.
775	4841	Bipartitana—*Clem.* Common.
		PÆDISCA. *Tr.*
776	4909	Scudderiana—*Clem.* Common.
777	4912	Otiosana—*Clem.* Rare.
778	4914	Dorsisignatana—*Clem.* Common.
		SEMASIA. *Steph.*
779	4919	Formosana—*Clem.* Rare.
		PROTEOPTERYX. *Wlsm.*
780	4958	Deludana—*Clem.* Common.
781	4959	Spoliana—*Clem.* Very common.
		PROTEOTERAS. *Riley.*
782	4962	Æsculana—*Riley.* Common.
		CARPOCAPSA. *Tr.*
783	5023	Pomonella—*Linn.* Common.
784	5026[1]	Aurichalceana. Common.
		HYPONOMEUTIDAE.
		HYPONOMEUTA. *Zell.*
785	5155	Longimaculella—*Cham.* Common.
		ARGYRESTHIA. *Hbn.*
786	5161	Andereggiella—*F. & R.* Rare.
		GELECHIIDAE.
		MACHIMIA. *Clem.*
787	5225	Tentoriferrella—*Clem.* Rare.

NATURAL HISTORY NOTES.

Bibliographical Notes on Wisconsin Forests. BY E. BRUNCKEN. The following does not lay claims to entire completeness, but as far as it goes may be of use to students. The note is made from the botanical rather than the economic standpoint, although several of the publications entered contain much information regarding the economic conditions also. The scantiness of the list is evidence of the fact that very little is really known in an accurate manner about the biological relations of the forests of the state.

BRUNCKEN, ERNEST.

Notes on the Distribution of Some Trees and Shrubs in the Vicinity of Milwaukee.

Bulletin of Wisconsin Natural History Society, January, 1900, pp. 31-42.

BRUNCKEN, ERNEST.

Some Remarkable Trees in the Vicinity of Milwaukee.

Bulletin of Wisconsin Natural History Society, January, 1900, pp. 43-45.

BRUNCKEN, ERNEST.

The Trees of Wisconsin. Milwaukee Sentinel, Special Carnival Edition, April 21, 1898. (Biological and Historical.)

CHAMBERLAIN, T. C.

Native Vegetation. Chapter III., Geology of Eastern Wisconsin. Report of Geological Survey, Vol. II. (Attempts a classification according to zones of distribution.)

With map in acompanying atlas.

HOY, B. R.

Notes on the Woods of Wisconsin.

Transactions Wisconsin State Agricultural Society. Vol. II., pp. 419 *et sequ.* 1852.

LAPHAM, I. A.

The Forest Trees of Wisconsin.

Transactions of Wisconsin State Agricultural Society. Vol. IV., pp. 195 *et sequ.*

LAPHAM, CROCKER AND KNAPP.

Report on the Disastrous Effects of the Destruction of Forest Trees.

Submitted to the State Legislature by the commissioners appointed for this purpose, 1867.

PAMMEL, L. H.
Forest Vegetation of the Upper Mississippi.
Garden and Forest, IV., pp. 461 *et sequ.* 1891.

PUTNAM, H. C.
Report on the Forests of Wisconsin with Particular Regard to the Lumber Industry.
In Sargent's Report on the Forests of the United States, Xth Census, Vol. 13, pp. 554-558.

ROTH, FILIBERT.
On the Forestry Conditions of Northern Wisconsin. Wisconsin Geology and Natural History Survey. Bulletin No. 1, Economic Series No. 1. Madison, 1898, Map, p. 78.
There are two editions of this work published by the state. One, on large heavy paper, distributed by the Geological Survey. The other in cheaper form, for the State Forestry Commission. See also next entry.

ROTH, FILIBERT.
Forestry Conditions and Interests of Wisconsin. With a discussion of objects and methods of ascertaining forest statistics, etc., by B. E. Fernow, Chief of Division of Forestry. Bulletin 16, U. S. Division of Forestry, 1898. Map, p. 76.
This is substantially the same work as the preceding, but does not contain the accounts of conditions in individual counties.

WARDER, JOHN A.
Forests and Forestry in Wisconsin.
Transactions Wisconsin State Horticultural Society, 1880-1881.

Notes on Sylva of Milwaukee County. BY ERNEST BRUNCKEN. The hop hornbeam *(Ostrya Virginica)*, a very common tree in this locality, seldom has a larger diameter than eight inches, although it is stated that in the lower Mississippi region, where it seems to have its best development, stems of twenty inches and more are not uncommon. The largest tree of this species in our vicinity, which I know of, stands on the steep northern slope of the Menomonee Valley, near the abandoned quarry opposite Castalia Park. It is about twenty-five feet high, has eleven inches diameter at breast-height; the spread of its crown about equals its height, and the lowest branch is eight feet above the ground. It is a very vigorous tree, and last autumn bore a heavy load of seed. This tree, standing free and showing the typical open-stand form, is evidently of "second growth." As the species is a slow grower, however, it may well be fifty years old. In the Jesup collection in the American Museum of Natural History, at New York, there is a log specimen from the northern part of that state which is twelve inches inside the bark, and shows seventy-six rings. The largest tree of this species on record seems to be one at West Stockbridge, Mass., which, in 1877, had a circumference, at four feet from the ground, of seven feet two inches, or twenty-seven inches diameter.

Shade trees of several species on the West Side have had their trunks colored conspicuously green, during the fall and winter, by some alga, possibly a *Pleurococcus.*

The year 1899, in the vicinity of Milwaukee, was a seed year for a number of trees. *Acer saccharinum* keys were very abundant on the shade trees along the city streets, and many seedlings sprouted on the lawns. The several species of oak all bore very abundantly. So did the hop hornbeam. Also the basswood.

A Rain of Frogs. BY ERNEST BRUNCKEN. The sudden occurrence of frogs in very great numbers, disappearing just as suddenly, has often been recorded, and led to the popular belief in a "rain of frogs." Such an appearance of frogs, due presumably to a migration, was noticed in the vicinity of Rush Lake, Winnebago County, in August, 1897. On the 25th of that month I noticed an unusual number of leopard frogs in the garden surrounding a farm house, about two miles from that lake, and not in the immediate vicinity of any large body of water. Upon inquiry I was told by the people living there that a few days before there had been "a hundred frogs where there is one now."

A "frog rain" is mentioned as occurring at Milwaukee in 1836 by Buck in his "Pioneer History." Other old residents claim that this phenomenon occurred in 1839, and it is stated that at that time frogs were taken out of the cellars and basements in the then village of Milwaukee "by the bushel basket full."

On the Occurrence of the Evening Grosbeak in Milwaukee in the Winter of 1899-1900. BY W. J. BENNETTS. The winter of 1899-1900 has been characterized at Milwaukee by the presence, in considerable numbers and after ten years' absence, of the evening grosbeak *(Coccothraustes vespertina)*. Their last occurrence in this vicinity was in January and February, 1890, and previous to that in the same months of 1888, and in March and April of 1887. On each occasion they were reported also from the majority of states between the Dakotas and the Atlantic, and as far south as southern Iowa and Kentucky. Small flocks have indeed been reported from other parts of Wisconsin in the interval since 1890, as a flock of five at Appleton, March 14, 1891, and another of about a dozen at Delavan, from January 21 to March 30, 1896, but in that period there seems to have been no general movement southeastward of these birds of the far northwest. As it is possible that their present wanderings may prove to be as extensive as those of 1887, '88, and '90, the notes that follow are given in the hope that they may assist in tracing the movements of these wandering flocks.

On November 5th of last year, 1899, I observed a solitary male of this species in a grove near Milwaukee-Downer College to the northeast of the city. It was flying restlessly from tree top to tree top, uttering a ringing metallic call and its large bill and peculiar markings were clearly distinguished through the field glass. Other single birds have been observed since then in the same locality and behaving in the same manner so that, although it was my first acquaintance with the species, I am satisfied there was no error in identification.

No more were reported until February 12th, when a boy brought a male bird, that had been shot with an air gun, to the Milwaukee Public Museum. It had been secured on the South Side of the city and was alone when taken. Another male was received under somewhat similar circumstances on February 18th, and on February 19th Mr. P. H. Dernehl found a flock of twenty-two—the majority of which were full-plumage males—on North Ave. near Second Street, feeding in a group of box-elder trees *(Acer Negundo)*, and a few blocks away met with four more, three of which were males. About February 5th, some boys had reported seeing a few large, yellowish-colored birds in the neighborhood of West Park, and on February 22d Mr. F. Kirchner found a flock of about a dozen grosbeaks in some evergreens just south of the park. On the morning of the 25th, I repaired to that locality and soon discovered, in a row of box-elder shade trees, a flock of twenty-five, sixteen of which were males in full plumage. Other places, where their favorite tree was abundant, were visited in the course of the day and in two cases successfully. A flock of eleven was found during the afternoon on Twenty-third Street, about a mile from where the flock of the morning was seen. These also were in box-elder trees and nine of the eleven birds were plainly males. Half a mile away on Wells Street, four more were met with, chasing one another among the elm trees, the males which were three in number, uttering their characteristic loud call-notes repeatedly as they flew. Whether the quieter colored birds—in brown and yellowish grey—of these flocks were females or immature males remains undecided, as no collecting was done; although from the character of their note I was inclined to the opinion that they were of the same sex as their more richly colored companions, as the note of the females was found to be—at least in the month of April—clearly different from that of the male.

One week later, on March 4th, during a heavy snow storm, I again repaired to West Park, which appeared to be the headquarters of our grosbeak visitors. Two rows of box-elder trees, laden with fruit, extend for about half a mile just east of the property, and here, as was the case before, the first flock was found. They were thirty-five in number and nineteen were males in mature plumage. Not far away, but in the center of the park, a small company of nine was found, and farther on one of sixteen. From some evergreens at the south end of the park the largest flock yet seen arose at my approach. They were estimated at being not less than one hundred and thirty in number, and flew rapidly northward, dividing into two flocks which disappeared in opposite directions. About a mile away, on Twenty-sixth Street a flock of nine was found. These were on the snow beneath the box-elder trees, picking up the fallen seeds.

During the entire month of March small flocks of a dozen or less could be found almost any day in some one of the localities mentioned. They were reported also from other and remote quarters of the city, and an examination made, personally, of box-elder trees in a cemetery some distance in the suburbs, gave unmistakable evidence that the birds had recently been feeding there also.

On March 28th a flock numbering more than a hundred .was observed by F. Kirchner in West Park. No more have been seen in that locality since, so it is possible that the smaller companies may have combined just previous to their departure.

On April 8th I discovered a flock of twenty-one, all females, in the town of Wauwatosa, a suburb just west of Milwaukee. Box-elder trees of a large size are numerous there and had been stripped almost entirely of their fruit by the birds, showing that the latter had been there for a considerable time and in large numbers. These female birds, while in the trees, kept up a loud, monotonous chattering that could be heard three blocks away and which was noticeably different from the quieter, sparrow-like chirping of the males under the same conditions. When on the ground both sexes, so far as observed, are almost silent. Soon after being noticed this flock flew to a garden plat near one of the residences and began industriously searching for food. They made use of their bills rather than of their feet—lifting up and turning over the fallen leaves and occasionally several could be seen at once holding leaves up in their bills and working them around and examining them closely. They hopped familiarly along the board walk, mounted the steps and peered into the rear entrance of the house, but would not permit of my approaching them nearer than about thirty feet. Later they flew to a small maple and remained almost silent for a considerable time, and finally when I left them they were again in the box-elders, searching for any seeds that might have escaped their previous visits.

Up to the time of writing these notes (April 16), this flock was the last known to have been in this vicinity.

The evidence thus far given would seem to show, then, that during the months of November, December and January, a few male birds—the scouts of the main grosbeak army—were present in the neighborhood of the city. The first flocks appeared about February 1st and were composed largely of males in full plumage and it is possible that many, if not all, of their sombre colored companions were also males—young immature birds.

Their numbers steadily increased and must have reached a maximum about the middle of March when the proportion of the sexes was about equal and when the grosbeak population of Milwaukee must have numbered many hundreds. Towards the end of the month their numbers appeared to diminish or at least the flocks were more difficult to find, and when found were composed chiefly of female birds, while the last companies that were noted here consisted exclusively of birds of that sex. Most of the accounts of former grosbeak visits agree in stating that but few full plumage males could be found in any of the flocks. The present migration must have been exceptional in this respect or else on former occasions the flocks could not have come under observation during the early part of their visit. As has been already stated the majority of individuals in this locality during the month of February consisted of handsome specimens of the fully developed male. A box-elder tree occupied by a number of birds of this sex was an interesting sight on a bright winter morning. Their striking colors of yellow, black and white, stood out conspicuous—if the observer were close at hand, but at a greater distance their markings so blended into the yellowish tints of the smaller twigs and samaras and the stronger and darker lines of the branches, that in a tree well loaded with mast, the grosbeaks were almost unnoticeable. During this month they were tame and unsuspicious, allowing the observer sometimes to approach within two or three feet, but if the hand were reached out to seize one, he very quickly avoided it. They were somewhat indolent in their manner of feeding, perching at one place upon a branch and reaching out on all sides for the seeds until no more were within reach, when they flitted to a new position and repeated the operation. The snapping of their powerful bills as they bit the box-elder keys in two was distinctly audible. The key is held crosswise and divided about half an inch from one end just beyond the seed by one side of the bill, while with the other the seed itself is pressed or worked out, the two parts of the key dropping to the ground together. While feeding the males kept up a continual peeping or chirping, not much louder and very similar to that made by as many English sparrows. Occasionally they all flew to the ground to pick up any seeds that might have fallen and while there were almost invariably silent. When tired of feeding they would sometimes fly to the roof of the nearest house and when there also be quite silent, especially about mid-day.

Grosbeaks are known to eat the mast and buds of the maple, the berries of cedar and climbing bittersweet and the seeds of apples, but on this occasion they seem to have given their attention almost exclusively to the seeds of the box-elder, probably because it was so abundant and was preferred by them. Particular pains were taken to determine if they fed upon the *buds* of this tree, as it is stated that they prefer the buds to the seeds, but in no instance were they observed to pay any attention to the former. During the snow storm of March 4th they ate the snow greedily, picking it in large mouthfuls from where it accumulated on the branches and in the forks of the trees. On one occasion they were seen to search hurriedly and unsuccessfully through an apple orchard which doubtless they had previously visited and thoroughly despoiled of any frozen fruit it might have contained.

When flying low, as from one feeding place to another not far away, their flight was undulating and only moderately fast, but when flying at a greater height it was direct and very rapid.

Note on the Food of the Canada Jay, *(Perisoreus canadensis)*. BY W. J. BENNETTS. The following was found in the stomach of a Canada Jay collected in Barron County, Wisconsin, on Nov. 15th, 1899. It will be noted that the list is characterized by considerable variety and that although a cold spell prevailed at the time insects were still to be obtained.

The stomach contained (1) five seeds of staghorn sumac *(Rhus typhina)*; (2) ten seeds unknown; (3) one carabid beetle; (4) one large weevel *(Phyncophora)*; (5) one Hymenopter; (6) one Hemipter *(Capsid)*; (7) one Tettix grasshopper; (8) several caterpillars; (9) bone of some batrachian, probably tree frog, and (10) bits of shell of mollusc.

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Vol. 1. (NEW SERIES.) JULY, 1900. No. 3.

BULLETIN
OF THE
WISCONSIN NATURAL HISTORY SOCIETY

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[The Bulletin of the Wisconsin Natural History Society is published quarterly and distributed by the Milwaukee Public Museum, an exchange with other publishing societies and institutions is solicited.]

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BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 1, New Series. **JULY, 1900.** **No. 3.**

Proceedings of the Wisconsin Natural History Society.

March 29, 1900 to July 5, 1900.

THURSDAY, MARCH 29, 1900.

Twenty-eight persons attended this meeting which was held as usual in the museum lecture room. President Peckham occupied the chair.

Messrs. A. F. Laue and Chas. Knopf were made ordinary members of the society and Mr. H. P. Hamilton of Two Rivers, Wis., a corresponding member.

The resignation of Mr. Armin Neitzke from membership was accepted.

A motion made by Chas. E. Monroe that the quarterly bulletin be henceforth mailed to all members was carried.

The attention of the society was called to the fact that all members who contemplated reading papers at any of the meetings should notify the secretary, and dates would be assigned them in the order in which the notifications were received.

Mr. C. E. Monroe then read an interesting paper of a popular character—entitled "Geological Rambles." The leading points of interest to the geologist in Milwaukee and Ozaukee counties were touched upon, and the principal fossils noted, and their geological significance detailed. Certain quarries and exposures in the vicinity of Port Washington were considered at some length, also the bluff moraines bordering on the lake between Mequon and Cudahy. Evidence was also given in support of the theory that the basins now occupied by Lake Michigan and the other Great Lakes were once occupied by the ocean.

THURSDAY, APRIL 26, 1900.

The general meeting for April was also the annual meeting of the society and was held in the usual place—the museum lecture room.

In the absence of the president, Mr. Ernest Bruncken presided over the meeting. Twenty-six persons were present.

The report of the secretary for the past twelve months was then read as follows,—

Secretary's Report for the Year from April 27th, 1899 to April 26th, 1900.

Number of general meetings held during the year	9
" section " " "	19
" directors " " "	1
Membership of the society, April 26, 1900	87
Members added to the society during the year	23

The following twelve papers were read at the general meetings during the year:

Rambles in Prehistoric France	Charles E. Doerflinger
The Hamilton Formation at Milwaukee	E. E. Teller
Local Botany	Philip Wells
Winter Habits of the Great Northern Shrike	W. J. Bennetts
Indian Dialects of the Algonquins	D. W. Fowler
Some Remarkable Trees in the Vicinity of Milwaukee,	E. Bruncken
Notes on the Distribution of some Trees and Shrubs in the Vicinity of Milwaukee	E. Bruncken
The Colors of Flowers	W. H. Dudley
Our Early Wild Flowers and their Insect Visitors	Dr. S. Graenicher
Practical Taxidermy	Geo. Shrosbree
The Giant Squid and Its Allies	Dr. H. Dorner
Geological Rambles	Chas. E. Monroe

In January of the present year, 1900, the society began the publication of its transactions in the form of an octavo quarterly, which it has named "Bulletin of the Wisconsin Natural History Society." The first number which contained about 70 pages and 4 plates was well received by the other publishing societies of America and Europe. The second or April number was at the time of writing about to leave the hands of the printer.

This report having been approved, the election of officers for the ensuing year was then taken up and the following were nominated and unanimously elected,—

For President	Edgar E. Teller
" Vice President	Dr. S. Graenicher
" Recording Secretary	Wm. J. Bennetts
" Corresponding Secretary	Lee R. Whitney
" Treasurer	John A. Brandon
" Librarian	Paul H. Dernehl

DIRECTORS OF SECTIONS.

Entomology	Charles E. Brown
Botany	Ernest Bruncken
Ethnology	W. H. Ellsworth
Mineralogy	Louis Lotz
Geology	Chas. E. Monroe
Ornithology	John A. Brandon

Chas L. Owen of Chicago was elected a corresponding member of the society.

Reports from the directors of the several sections were then heard, after which those present listened with much interest to a paper entitled "Dakota Indian Mounds," by Lee R. Whitney. Mr. Whitney in the fall of 1899 had taken advantage of a visit to Ransom county in N. Dakota to dig into a series of mounds on the bluffs of the Cheyenne River, and in the paper he described the results of his explorations, and to illustrate it exhibited several skulls and Indian implements he had there unearthed.

Messrs. Geo. A. West and Chas. E. Brown took part in the discussion that followed.

The secretary was instructed to convey the thanks of the society to the retiring officers Dr. Peckham and Mr. F. Meinecke for their efficient services during the year that was past, after which there being no further business to transact the meeting was adjourned.

THURSDAY, MAY 31, 1900.

The general meeting for May was held in the trustees' room of the public museum with president Teller in the chair and 23 persons present.

Paul H. Dernehl reported upon a joint meeting of the biology sections that had been held on the 10th of the month, and Lee R. Whitney upon a meeting of the archaeology section that had been held at the home of Mr. Geo. A. West.

Mr. E. Bruncken then commenced the lecture of the evening taking "Forestry" as his subject. He drew attention to the many misconceptions that existed concerning the meaning of this term and defined forestry as the art of providing the United States and the world with one of the necessities of life—timber and wood.

This the forester aimed to do—not by planting trees—but by taking advantage of the natural laws governing forests and trees. With moisture and light he was most concerned. The first however was in most cases beyond his control so his methods related mostly to the other. It was shown how—in regard to their ability to endure shade—trees could be classified as tolerant and intolerant, and that the succession of trees depended upon their relationship in this respect. The opinion so current among lumbermen that the white pine will not succeed itself was shown to be a fallacy. Attention was also called to the inevitable extermination of the hemlock on account of its extremely slow growth and its dependence upon a humid soil for its existence. The speaker drew attention to the spreading of the forests in the southern part of the state and their encroachment upon the prairies and explained it as being largely due to the absence of destructive prairie fires which formerly killed all the young trees.

In closing Mr. Bruncken impressed upon his hearers the importance of their influencing legislators by all means in their power regarding the importance of re-foresting the denuded tracts of our state, as well as the preventing of the unwise destruction of forests now existing.

The following were nominated for membership by Mr. H. Nehrling and elected by the directors at the close of the meeting,—Messrs. Chas. L. Kiewert, Aug. Cloos, A. T. Schoenebeck and Carl Schoenebeck.

Mr. Slocum called the attention of the meeting to the Mining Congress that was shortly to assemble in the city and to the interesting exhibit of minerals that could then be seen at the Exposition building.

The meeting was then adjourned.

THURSDAY, JULY 5, 1900.

This meeting was held in the usual place, the museum lecture room. President Teller occupied the chair and 28 persons were present.

Chas. E. Monroe of the geology section spoke at some length on the relation of the formation known as the Lower Heldeburg to those lying immediately below and above it, viz: the Upper Silurian and the Hamilton, and stated that geologists were at present undecided with which it was the more closely connected. The speaker said however he hoped during the summer to obtain considerable evidence tending to settle the question by taking advantage of the opening of a quarry at Lake Church in Ozaukee county which cut into this formation.

Ernest Bruncken described the botanical features of the sand dunes at Ottawa Beach in Michigan. They there exhibit all stages of formation and are heavily forested with pine and hemlock, with an underbrush of hardwood. Willows of several species are abundant. Sassafras and tupelo were also noted.

Mr. Teller then spoke on the crustaceans found in the Niagara Formation of this vicinity and illustrated his remarks by means of specimens of the different fossils taken from his own collection.

Mr. Geo. A. West then related an exciting experience he had had while collecting specimens of the Sea Devil C. Vampirus off the west coast of Florida. He also gave a detailed description of the form and anatomy of this creature and exhibited specimens of its eyes and whip-like tail.

Chas. E. Brown suggested the formation of a sub-section of numismatics in connection with the archaeology section, and it was thought best to leave the matter with the members of that section.

The following were elected to membership,—Messrs. David Harlowe, W. F. Sandrock, Geo. J. Cline and Dr. H. V. Ogden.

W. J. BENNETTS, Recording Secretary.

The Fertilization of Symphoricarpos and Lonicera.

By Dr. S. GRAENICHER.

Symphoricarpos and Lonicera are two closely related genera, belonging to the Caprifoliaceae or honeysuckle-family. In our flora these two genera, taken together, are represented by 7 species of plants, all of which occur in the immediate vicinity of the city of Milwaukee.

Symphoricarpos, Juss.

One of our species, *Symphoricarpos racemosus, Michx.*, has been enumerated among the so called "wasp-flowers" ever since H. Mueller (1) in giving an account of the fertilization of this species, mentioned the fact that wasps are among the principal visitors of the flowers. His observations were made on plants of this species, growing at different points in Germany, and furnished the remarkable results that in a certain part of that country, with an abundance of wasps, the latter formed over nine tenths of the visitors, while in an other locality, where wasps seemed to be scarce, bees were the most frequent visitors. More recent investigators have obtained similar results, as for example Knuth (2), who for years never succeeded in witnessing the visit of a single wasp on *Symphoricarpos racemosus* in Pommerania, until in 1897, when wasps, belonging to several species were numerous on these flowers in Usedom, an island on the coast of Pommerania. This is significant, and shows that the extent to which these flowers receive the attention of wasps in a given locality, depends mainly on the frequency, with which wasps occur in that locality. Where wasps are few in number, the flowers are visited efficiently by a variety of other insects, mostly bees and flies, and according to MacLeod's (3) observations in Flanders by moths (Noctuidae). For this reason there has been a tendency on the part of a few observers to drop the term "wasp-flower", the visits of wasps to such a flower being, in their opinion of no more importance than the visits of wasps to any other flower. But the fact must be admitted that a wasp-flower is more attractive to wasps, than is the ordinary beeflower. The dimensions of such a flower, together with its bellshaped or cup-shaped form, enable wasps to thrust their heads into the flower in search of nectar, which is usually secreted in abundance. A wasp-flower is therefore simply a bee-flower, which owing to certain peculiarities in form and structure, favors the visits of wasps to some extent. Taken in this sense, the term "wasp-flower" undoubtedly has a right to stand.

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(1) H. Mueller. Die Befruchtung der Blumen durch Inseckten, 1873. pp. 360–361.

(2) P. Knuth. Handbuch der Bluetenbiologie, 1898. Vol. II, Part 1, p. 527.

(3) MacLeod. Untersuchungen ueber die Befruchtung der Blumen. Bot. Centralblatt. Vol. XXIX, p. 119, 1887.

The genus Symphoricarpos has 2 representatives in this part of the country: *S. racemosus, Michx.,* and *S. occidentalis, Hook.,* which differ somewhat from each other, as regards the structure of the flowers.

Symphoricarpos racemosus, Michx. Snowberry.

(See Frontispiece. Fig. 1)

This is a rather common plant around Milwaukee, forming in many places small patches, and blooming from June 6. to July 25. The reddish, bellshaped flowers are collected in clusters at the ends of the branches, and are more or less pendulous. As the stamens are inclined towards the middle of the corolla tube, the introrsely opening anthers form a small circle a short distance above the stigma. Honey is secreted in the lower portion of the tube, and is protected by patches of hairs, arising from the inner surface of the tube, and filling out the entrance to the flower. This species presents a case of homogamy, the stigma being receptive at the same time the anthers shed their pollen. From the situation of the anthers in advance of the stigma it is evident that pollen can not fall on the stigma and effect spontaneous self-fertilization, unless the flowers be erect, which usually is not the case. Besides, there is hardly ever a necessity for the flowers to resort to spontaneous self-fertilization, as they are abundantly visited by insects. Proceeding from flower to flower with grains of pollen attached to the lower parts of their heads, the visitors are liable to insure cross-fertilization, but they may also carry pollen from the anthers to the stigma of the same flower.

Symphoricarpos racemosus is a native of this country. The flowers of this species from plants growing in our neighborhood are decidedly smaller than those observed by H. Mueller in Germany, on cultivated specimens. This author gives a length of 7 to 8 mm., and a width of 5 mm. for the flowers, while those from our locality attain a length not exceding 6 mm., and a width of not more than 4 mm. Observations of the visits of insects to these flowers have been recorded from different parts of Europe, but none from this country. Robertson (4) has published an account of the fertilization of *Symphoricarpos symphoricarpos*

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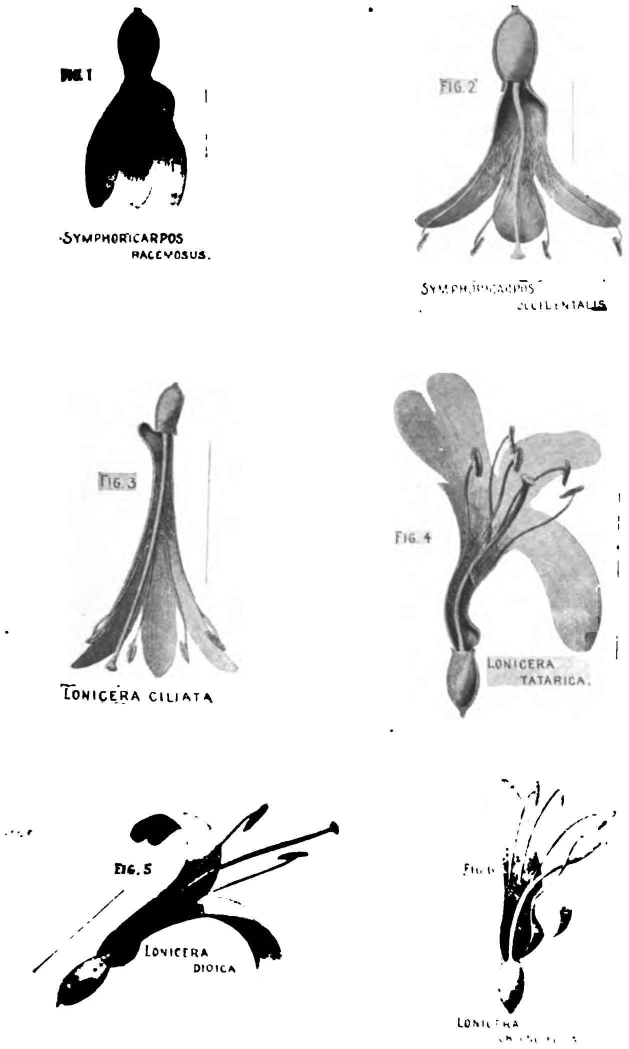
(4) C. Robertson. Flowers and Insects. Trans. Acad. Sc. St. Louis, Vol. VII, No. 6, pp 173-174.



FLOWERS OF SYMPHORICARPOS AND LONICERA. *See Page* 141.

DRAWN BY JOHN A. BRANDON.

[The straight lines represent the natural size of the flowers.]

(*L*), *MacM.* (*S. vulgaris, Michx.*), a North American species, agreeing in most respects with *S. racemosus.* His list refers to 14 visitors, observed in Macoupin Co., Southern Illinois, 7 or 50 per cent. of which are wasps (Vespidae and Eumenidae).

During the last two seasons, I have taken the following insects on the flowers of *Symphoricarpos racemosus, Michx.*

A. Hymenoptera.

Apidae: (1) *Apis mellifica,* L. ☿*; (2) *Bombus americanorum, F.* ☿ ; (3) *B. consimilis, Cr.* ☿ ♀ ; (4) *B. fervidus, F.* ♀ ; (5) *B. pennsylvanicus, DeG.* ♀ ; (6) *B. ternarius, Say.* ♀ ☿; (7) *B. virginicus, Oliv.* ♀; (8) *Clisodon terminalis, Cr.* ♀; (9) *Megachile latimanus, Say.* ♀ ; (10) *M. melanophaea, Sm.* ♀; (11) *Alcidamea producta, Cr.* ♂; (12) *Osmia albiventris, Cr.* ♂; (13) *O. distincta, Cr.* ♀ ; (14) *O. simillima, Sm.* ♀; Andrenidae: (15) *Halictus fasciatus, Nyl.* ♀ ; (16) *H. similis, Sm.* ♀; (17) *H. inconspicuus, Sm.* ♀; (18) *Agapostemon radiatus, Say.* ♀; (19) *A. viridulus, F.* ♀; (20) *A. splendens, Lep.* ♀; (21) *Augochlora vividula, Sm.* ♀; (22) *Andrena bipunctata, Cr.* ♀; (23) *A. pruni, Rob.* ♀; (24) *A. vicina, Sm.* ♀; (25) *A. zabriskiei, Ashm.* (M. S.) ♀; (26) *Andrena sp.* ♀ ; (27) *Colletes aestivalis, Patton* ♀ ; (28) *Prosopis modesta, Say.* ♀; Vespidae: (29) *Vespa diabolica, Sauss.;* (30) *V. vidua, Sauss.;* Eumenidae: (31) *Eumenes fraternus, Say.* (32) *Odynerus foraminatus, Sauss.;* (33) *O. philadelphiae, Sauss.;* (34) *O. tigris, Sauss.;* Sphecidae: (35) *Ammophila vulgaris, Cr.—;* all s.

B. Diptera.

Syrphidae: (36) *Eristalis bastardi, Macq.;* (37) *E. dimidiatus, Wied.;* (38) *Helophilus conostomus, Will.;* (39) *H. similis, Macq.;* (40) *Tropidia quadrata, Say.;* Conopidae: (41) *Zodion fulvifrons, Say.;* Tachinidae: (42) *Belvosia bifasciata, F.;* (43) *Sturmia albifrons, Walk.;* (44) *Tachina robusta, Town.;* (45) *Peleteria robusta, Wied.;* (46) *P. tessellata, F.;* (47) *Archytas analis, F.;* Muscidae: (48) *Phormia regina, Mg.;* (49) *Lucilia cornicina, F.*—all s.

C. Lepidoptera.

Rhopalocera: (50) *Neonympha eurytus, F.;* (51) *Phyciodes tharos, Drury;* (52) *Anosia plexippus, L.;* (53) *Lycaena pseudargiolus, Boisd.—Lec.;* (54) *Thorybes pylades, Scudder;* Heterocera: (55) *Alypia octomaculata, Hbn.;* (56) *Plusia simplex, Gn.;* (57) *Leucania unipunctata, Haw.*—all s.

D. Coleoptera.

Scarabaeidae: (58) *Trichius piger, F. s.*

This list is made up of a great variety of insects, prominent among them being the bees (Apidae and Andrenidae) with about fifty per cent. of the visitors, while the wasps are represented by six species or hardly ten per cent. This result is not surprising, when we consider the fact that wasps, and especially those belonging to the genus Vespa occur in small numbers in our neighborhood and have been remarkably scarce for the last two seasons. And besides, the total number of visiting species is so large that the percentage of wasps is necessarily reduced to a low rate.

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* ☿ Worker; ♂ Male; ♀ Female; s Sucking; c p Collecting Pollen; f p Feeding on Pollen.

In addition to the bees and wasps observed on the flowers, flies belonging to the families Syrphidae and Tachinidae and butterflies appear as regular visitors.

Symphoricarpos occidentalis, Hook. Wolfberry.

(Fig. 2.)

Although not as widespread as the preceding species, it occurs in abundance in a few places in the Menomonee Valley, growing in large patches. The blooming period is from June 15. to August 26. The clusters of reddish flowers are situated either at the ends of the erect or nodding branches or in the axils of the leaves. The numerous sweet scented flowers may be observed in all positions between erect and pendulous. There is a contrast of color between the white inner surface of the open flowers and the distinct reddish color of the buds and thereby the conspicuonsness of the inflorescence is increased. In the open flower the lobes of the corolla are spread outwardly, giving the flower the shape of a funnel and rendering it more accessible to short-tongued and less-specialized visitors than the bellshaped flower of *S. racemosus,* with its erect corolla lobes. When the lobes are entirely spread, the flower attains a diameter of 10 mm., while the entrance to the corolla tube at the base of the lobes is only 3 mm. wide. In this species, as in the preceding, the entrance is closed by tufts of dense, white hairs and in this way the nectar is protected to a certain extent from the visits of unwelcome guests but especially from rain. Nectar is secreted at the bottom of the tube, but it also appears in minute drops on the layer of succulent tissue, which lines the interior surface of the tube. The depth of the tube being only 4 mm. and its width of 3 mm. at the entrance enabling insects to insert the lower part of their heads, it is evident, that honey can be procured by relatively short-tongued visitors. The erect style, bearing the small capitate stigma arises from the middle of the flower and protrudes from the latter for a length of 4 mm., being altogether 8 mm. long. The stamens attain the same length as the style, they are strongly divergent and for this reason the anthers are not likely to come in contact with the stigma. There is a slight dilation of one side of the corolla tube in its lower portion, which is more pronounced in the bud.

The flowers are homogamous and the introrse anthers open gradually, one by one. Insects insert their heads, as a rule between the stigma and the anthers. Visiting flower after flower, with the sides of their heads dusted with pollen, they naturally convey pollen to the stigmas which are on the same level with the anthers and usually effect cross-fertilization. Spontaneous self-fertilization may take place by the falling of pollen on the stigmas when the flowers are horizontal or pendulous; in erect flowers this can not occur.

In the following I give a list of insects taken on the flowers in the summer of 1899:

A. Hymenoptera.

Apidae: (1) *Apis mellifica, L.* ☿; (2) *Bombus americanorum, F.* ☿; (3) *B. consimilis, Cr.* ☿♀; (4) *B. fervidus, F.* ☿; (5) *B. pennsylvanicus, Deg.* ☿; (6) *B. pleuralis, Nyl.* ♀; (7) *Ceratina dupla, Say.* ♀; (8) *Osmia atriventris, Cr.* ♀; (9) *Nomada affabilis, Cr.* ♀; Andrenidae: (10) *Halictus fasciatus, Nyl.* ♀; (11) *H. similis, Sm.* ♀; (12) *Halictus sp.* ♀; (13) *Agapostemon, radiatus, Say.* ♀; (14) *A. viridulus, F.* ♀; (15) *Andrena claytoniae, Rob.* ♀; (16) *A. forbesii, Rob.* ♀; (17) *A. rugosa, Rob.* ♀; (18) *Colletes eulophi, Rob.* ♀; (19) *Sphecodes dichrous, Sm.* ♀; Vespidae: (20) *Vespa germanica, F.*; (21) *V. maculata, L.*; (22) *Polistes pallipes, Lep.*; Eumenidae: (23) *Eumenes fraternus, Say.*; (24) *Odynerus capra, Sauss.*; (25) *O. foraminatus, Sauss.*; (26) *O. leucomelas, Sauss.*; (27) *O. tigris, Sauss.*; (28) *O. walshianus, Sauss.*; Crabronidae: (29) *Crabro interruptus, Lep.*; Philanthidae: (30) *Philanthus bilunatus, Cr.*; (31) *P. punctatus, Say.*; (32) *Cerceris fumipennis, Say.*; (33) *C. nigrescens, Sm.*; Bembecidae: (34) *Bembex spinolae, Lep.*; Larridae: (35) *Tachytes pepticus, Say.*; Sphecidae: (36) *Ammophila vulgaris, Cr.*; (37) *Pelopoeus cementarius, Drury*; (38) *Sphex ichneumonea, L.*; (39) *S. pennsylvanica, L.*; Pompilidae: (40) *Pompilus tenebrosus, Cr.*; Scoliidae: (41) *Scolia confluenta, Say.*—all s.

B. Diptera.

Syrphidae: (42) *Syrphus americanus, Wied.*; (43) *Allograpta obliqua, Say.*; (44) *Mesogramma geminata, Say.*; (45) *M. marginata, Say.*; (46) *Sphaerophoria cylindrica, Say.*; (47) *Eristalis bastardi, Macq.*; (48) *E. dimidiatus, Wied.*; (49) *E. flavipes, Walk.*; (50) *E. meigenii, Wied.*; (51) *E. transversus,* *Wied.;* (52) *Helophilus similis, Macq.;* (53) *Mallota cimbiciformis, Fall.;* (54) *M. posticata, F.;* (55) *Tropidia quadrata, Say.;* (56) *Syritta pipiens, L.;* Stratiomyidae: (57) *Stratiomyia norma, Wied.;* Tachinidae: (58) *Hyalomyodes triangulifera, Loew.;* (59) *Ocyptera carolinae, Desv.;* (60) *Peleteria robusta, Wied.;* (61) *P. tessellata, F.;* Muscidae: (62) *Stomoxys calcitrans, L.;* (63) *Calliphora erythrocephala, Mg.;* (64) *Phormia regina, Mg.;* (65) *Lucilia caesar, L.;* (66) *L. cornicina, F.;* (67) *Graphomyia americana, Desv.;* (68) *Morellia micans, Mg.;* Sarcophagidae: (69) *Sarcophaga sarraceniae, Riley;* (70) *Sarcophaga sp.*—all s. or f. p.

C. Lepidoptera.

Rhopalocera: (71) *Basilarchia disippus, Gdt.;* (72) *B. astyanax, F.;* (73) *Pyrameis atalanta, L.;* (74) *P. huntera, F.;* (75) *Argynnis cybele, F.;* (76) *Phyciodes tharos, Drury;* (77) *Anosia plexippus, L.;* (78) *Libythea bachmanni, Kirtl.;* (79) *Chrysophanus thoe, Boisd.—Lec.;* (80) *Lycaena pseudargiolus, Boisd.—Lec.;* (81) *Colias philodice, Gdt.;* (82) *Limochores manataaqua, Scud.;* (83) *L. taumas, F.;* Heterocera: (84) *Hemaris diffinis, Bdv.;* (85) *Plusia simplex, Gn.*—all s.

D. Coleoptera.

Scarabaeidae: (86) *Trichius piger, F.* s.

The results obtained from a comparison of this list with that of *S. racemosus,* are in accordance with what might be expected on account of the difference in structure of the two flowers. The percentage of true wasps (Vespidae and Eumenidae) is the same on both species, amounting to ten per cent. The bellshaped flowers of *S. racemosus,* with their more concealed nectar are more attractive to bees (48 per cent.) than the funnelshaped flowers of *S. occidentalis,* with their shorter corolla tube (22 per cent. of bees). The latter show a decided increase in the visits of less-specialized insects, notably entomophilous and fossorial wasps and flies. Instead of 1 entomophilous wasp or hardly 2 per cent. in S. racemosus, we have 13, or 15 per cent. of the visitors belonging to the entomophilous and fossorial wasps in *S. occidentalis;* the increase in the visits of flies is from 24 per cent. in *S. racemosus* to 34 per cent. in *S. occidentalis.* Both species of Symphoricarpos receive the attention of Lepidoptera, but *S. occidentalis* seems to be the more attractive of the two to this order of insects. *Trcihius piger,* the only beetle frequenting both species is a regular visitor, which succeeds in forcing its head into the flowers in search of honey.

For the sake of comparison, I add the following table; it refers to observations made in this country, as well as in Europe on the fertilization of the species of Symphoricarpos.

		Bees.	Vespidae and Eumenidae.	Other Wasps.	Diptera.	Lepidoptera.	Coleoptera.	Total.
S. symphoricarpos (5)	Southern Illinois	5	7	2				14
S. racemosus (6)	Germany	7	8	1	1			17
S. racemosus (7)	Germany	2	4		6			12
S. racemosus [8)	Belgium					8		8
S. racemosus	Milwaukee, Wis.	28	6	1	14	8	1	58
S. occidentalis	Milwaukee, Wis.	19	9	13	29	15	1	86

Lonicera, L. Honeysuckle.

Lonicera furnishes an example of a genus, producing numerous species, which present a great amount of variation in their floral characters, and, for this reason are adapted to various kinds of visitors. The main factor which separates the species from each other is the variation in length and width of the corolla tube, while points of minor importance, such as difference in length of stamens and style, in color, in position of the flower (erect or pendulous) etc., have also a determining effect. The length of the corolla tube in the different species corresponds more or less with the length of the tongues of their visitors and accordingly we come across wasp-flowers, bee-flowers, bumble-bee-flowers, hawk-moth-flowers and bird-flowers among the honeysuckles.

Lonicera alpigena, L., a native of the Alps has a short wide-mouthed tube and is visited mainly by wasps. This is the only wasp-flower among the species of Lonicera. Other short-tubed species are adapted to the smaller bees, while in the bumblebee-flowers the tube ranges from 4 mm. to about 20 mm. in length. Two European honeysuckles, *L. periclymenum, L.* and *L. caprifolium, L.* are fertilized by hawk-moths in the evening and have long, narrow tubes of 22 to 30 mm. in length. The trumpet-honeysuckle, *L. sempervirens, Ait.* with its bright scarlet flowers is a native of this country, but occurs in our latitude in a cultivated state only. The slender flowers attain a length of 25 to 35 mm. and are adapted to the ruby-throated humming-bird, *Trochilus colubris, L.*

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(5) C. Robertson, loc cit., p. 174. (7) H. Mueller, loc. cit., p. 361 and Weitere Beobachtungen, Vol. III, p. 73. (7) E. Loew. Weitere Beobachtungen ueber d. Blumenbesuch von Insekten, etc., Jahresb. d. Bot. Gart. Berlin, Vol. IV. p. 99. (8) MacLoed, loc. cit., p. 119.

Five species of Lonicera belong to the flora of Milwaukee County, four of which are indigenous, while the fifth, *L. tatarica, L.*, has escaped from our gardens and has succeeded in gaining a strong foothold at various points around the city. In this country observations have been recorded on the fertilization of 2 of our species: *L. ciliata*, Muhl. and L. *Sullivantii*, Gray and in Germany on *L. tatarica, L.*, while of our 2 remaining species: *L. dioica, L.* and *L. oblongifolia, Muhl.* no account has been given as yet. In the following the species are to be considered in the order of the appearance of their first flowers.

Lonicera ciliata, Muhl. American Fly Honeysuckle.

(Fig. 3.)

This is the earliest of our honeysuckles, its blooming period extending from May 4. to May 17. It figures on Wheeler's list of the flora of Milwaukee County, but seems to be a rare plant in our surroundings; the only specimen I have ever seen, was found about half a mile west of Soldier's Home, in Johnson's woods, in the spring of the present year. Lovell (9) has given an account of the fertilization of this species and reported the visits of a bumble-bee, *Bombus vagans, Sm.* ♀ "and several small bees", without mentioning the names of the latter. The greenish-yellow flowers are pendulous and have a funnel-shaped corolla of 16 mm. length, 11 mm. of which indicate the length of the tube. The five lobes of the corolla being equal, there is not the slightest trace of the formation of an upper and a lower lip, as is often the case with honeysuckles. Near its base the tube bears a spur-like gibbosity, the seat of the nectary and which is usually filled with honey. The corolla tube has a width of 5 mm. at its mouth but it gradually becomes narrower towards the base. Hairs on the wall of the tube in its narrower portion prevent the nectar from flowing downward and protect it somewhat from unbidden guests. As soon as the lobes of the corolla open, the capitate stigma, which is already receptive, appears in the mouth of the corolla, about 2 mm. in advance of the anthers. A short time later the anthers begin to empty their pollen. Proterogyny is therefore present, but in a slight degree only.

The width of the tube enables small bees of the genera Osmia and Halictus to crawl up into the flower and obtain nectar, while larger bees, as for example the species of Andrena observed as visitors can insert their heads only. The position of the stigma in the entrance to the flower and in advance of the anthers favors cross-fertilization, as the insects are apt to strike the stigma before reaching the anthers. Their visits to newly opened flowers, before the anthers dehisce, can have only one result: cross-fertilization. The stigma may be bent over to one side and touch one of the anthers, with the possibility of effecting spontaneous self-fertilization; this may take place in older flowers especially, where the corolla tube grows longer and brings the anthers nearer to the stigma. In this manner the flowers may finally resort to spontaneous self-fertilization in case fertilization through insect-agency has not been accomplished. Besides being well supplied with nectar, the flowers are fragrant. I have seen them visited frequently by the following bees.

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(9) John H. Lovell. The Visitors of the Caprifoliaceae. The American Naturalist, Vol. XXXIV, p. 45, 1900.

Apidae: (1) *Osmia atriventris, Cr.* ♂, ♀, s.; (2) *O. distincta, Cr.* ♂ *s;* Andrenidae: (3) *Halictus quadrimaculatus, Rob.* ♀, s. and cp.; (4) *Halictus sp.* ♀, s.; (5) *Andrena vicina, Sm.* ♀, s.; (6) *A. pruni, Rob.* ♀, s.

The length of the corolla tube points to an adaptation to bumble-bees, and Lovell has, as stated above, observed this kind of visitors in New England. Although I did not witness the visit of a single bumble-bee to the relatively small number of flowers under observation, yet, I entertain no doubts as to their paying attention to these flowers in our locality.

In color, size, structure and position of the flower, this species agrees closely with *Lonicera coerulea, L.,* a bumble-bee-flower growing in the alpine region, the fertilization of which has been observed first by Ricca (10).

Lonicera tatarica, L. Tartarian Bush-Honeysuckle.

(Fig. 4.)

This species, a native of Siberia, is a favorite shrub in our gardens, and grows in a wild state along the eastern bank of the Milwaukee river above the city, west of the city in the Menomonee valley and in various other places. Its blooming season is from May 20 to June 11. The flowers which are found in our neighborhood agree in a general way with the description given by Hermann Mueller (11) of flowers observed in Germany on cultivated specimens. They stand erect, in pairs, are white or rose-colored and have a corolla tube of 7 mm. length, which is slightly curved and somewhat dilated on the outer side near the base, so as to form a nectar-producing gibbosity. The tube is narrower than in the preceding species, having a width of 3 mm. at the mouth and 1½ mm. near the base. The long lobes of the

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10. Ricca. Osservazioni sulla fecondazione incrociata dei vegetali alpini e subalpini. Atti. Soc. Ital. Sc. XIV. 255.

11. H. Mueller. Die Befruchtung der Blumen, etc., p. 363.

corolla are arranged so, that the outer one forms a lower lip, a convenient landing place for insects, while the 2 adjoining lobes are directed laterally and the 2 remaining ones, which are hardly separated from each other, represent the upper lip. The slightly divergent stamens protrude from the flower for a length of 6 mm. and shed their pollen at about the same time the stigma becomes receptive. The latter reaches as far as the middle of the dehiscent anthers and may easily come in contact with them and cause spontaneous self-fertilization to take place. There is a change of color in the older flowers, they become yellowish. The nectar is protected by thin, white hairs arising from the walls of the tube as also from the style. The sweet-scented flowers attract numerous visitors belonging to the following species:

A. Bees.

Apidae: (1) *Bombus americanorum, F.* ♀, s.; (2) *B. bimaculatus, Cr.* ♀, s.; (3) *B. consimilis, Cr.* ♀, s.; (4) *B. ternarius, Say.* ♀; s.; (5) *B. virginicus, Oliv.* ♀; s.; (6) *Megachile brevis, Say* ♀, s. and cp.; (7) *Osmia albiventris, Cr.* ♀, s. and cp.; (8) *O. distincta, Cr.* ♀, s. and cp.; Andrenidae: (9) *Halictus similis, Sm.* ♀, s.; (10) *H. fasciatus, Nyl.* ♀, s.; (11) *H. quadrimaculatus, Rob.* ♀, s.

B. Flies.

Syrphidae: (12) *Mesogramma marginata, Say,* f.p.

C. Hawk-Moths.

Heterocera: (13) *Hemaris diffinis, Bdv.,* s.

D. Birds.

(14) *Trochilus colubris, L., s.* .. ..

The bumble-bees and the smaller bees of the genus Halictus usually insert their heads between the anthers and the stigma and transport pollen on the sides of their heads from one flower to another. The bees belonging to the genera Megachile and Osmia collect pollen from the flowers and to this end they press the brushes on the ventral surface of their abdomen down against the anthers, thereby coming in contact with the stigma and effecting either cross- or self-fertilization. On account of the shortnes of the style and the stamens, the visiting hawk-moth, *Hemaris diffinis* rarely touches the anthers or the estigma with the under side of its body, its visits are for this eason of little or no avail to the flowers. The visit of the small-sized Syrphid-fly is of no significance. Our humming-bird, *Trochilus colubris, L.*, an occasional visitor, may carry pollen on its beak and act as a cross-fertilizer.

In *Lonicera tatarica* we have an adaptation to the smaller bees, such as Osmia, Megachile, Halictus, etc.; this is indicated by the short tube, the short stamens and style and the erect position of the flower.

Lonicera dioica, L. Smooth-Leaved Honeysuckle.

(Fig. 5.)

A common species, blooming from May 22 to June 7. The flowers are collected in whorls at the ends of the branches, a branch bearing, as a rule, two whorls of about 6 flowers each. They are usually of a dark purplish color, but occasionally plants are found in our neighborhood producing greenish-yellow flowers only. While in the bud, the flower is erect, but after opening it assumes a horizontal position. The corolla tube is 8 mm. long and 4 mm. wide at its mouth and becomes only slightly narrower towards its base. Immediately above the base is a distinct dilation of the tube, the seat of the nectary. Numerous hairs, growing on the inner surface of the tube, afford protection to the deeply concealed nectar. The outer lobe of the corolla, representing the lower lip, is directed downward, while the remaining lobes participate in the formation of an upper lip. The anthers are situated 9 mm. above the entrance to the corolla tube, but they are 3 mm. behind the stigma. In some flowers the anthers begin to shed their pollen within the bud, a very short time before the latter opens; in other cases newly opened flowers may be observed with the anthers still closed. There certainly exists much irregularity in this respect, while of the stigmas it may be stated, that they always emerge from the bud in a receptive condition. Accordingly we have either a case of homogamy or of short-lived protenogyny. Inside of the bud, which is about to open, the capitate and receptive stigma is firmly pressed against one of the corolla lobes; in this way contact between the stigma and one of the prematurely opening anthers is prevented and for this reason spontaneous self-fertilization can hardly take place within the bud.

In favorable weather the flowers of this species open at all hours throughout the day. *Lonicera dioica* is a bumble-bee flower. Bumble-bees are the visitors, which on account of the length of the stamens and style are the most capable of coming in contact with the anthers and the stigma, while sucking honey. Cross-fertilization is favored by the stigma being in advance of the anthers, as the visiting bumble-bee is likely to strike the stigma before the anthers. I have seen the following insects on the flowers:

A. Bees.

Apidae: (1) *Bombus americanorum, F.* ♀, s.; (2) *B. consimilis, Cr.* ♀, s. and cp.; (3) *Osmia albiventris, Cr.* ♀, s. and cp.; (4) *O. distincta, Cr.* ♀, s.; (5) *O. atriventris, Cr.* ♀, s.; (6) *O. simillima, Sm.* ♀, s.; Andrenidae: (7) *Halictus coriaceus, Sm.* ♀, cp.; (8) *H. fulvipes, Sm.* ♀, cp.; (9) *H. similis, Sm.* ♀, s.

B. Birds.

(10) *Trochilus colubris, L.*

The most frequent visitor seen on the flowers was one of our bumble-bees; *Bombus consimilis.* The visits of the smaller bees (Osmia and Halictus) are of little importance to the flowers, as they may obtain honey and pollen, without touching the stigma. On one occasion a small bee: *Halictus fulvipes* was observed collecting pollen by first alighting on the corolla, climbing up a filament to the anther, descending with a load of pollen. climbing up a neighboring filament, and so on. In mistaking the style for a filament, it climbed up to the stigma, crawled over the latter before discovering its mistake and undoubtedly deposited grains of pollen on the stigma. As it repeated this procedure on several flowers, always making the mistake with the style, it may in this peculiar way have caused either self- or cross-fertilization.

This honeysuckle is also visited by the hummingbird.

Lonicera oblongifolia, Muhl. Swamp Fly-Honeysuckle.

(Fig. 6.)

This is the rarest of the honeysuckles in our locality, a few full grown specimens still lingering in damp soil in the Menomonee Valley, at the foot of the bluffs, west of Wells Street Viaduct. The blooming season is short, from May 30 to June 10. The erect flowers are situated in pairs on long, slender peduncles. They are yellowish-white, more greenish towards the base, but a change of color to light purplish takes place in the older flowers, mostly on the third day. The corolla has a length of 12 mm., but it is deeply cleft between the two lips, leaving only 4 mm. for the length of the tube. As the two flowers of a pair stand close together, their entirely erect upper lips nearly come in contact with each other; the slender lower lip is recurved to one side of the flower. The short tube of the corolla is 2 mm. wide at its mouth, but lower down it becomes dilated, forming a honey secreting gibbosity. Dense, white, wooly hairs, arising from the upper portion of the tube, as also from the style and the filaments, protect the honey in the erect flowers from rain and probably from the visits of intruders, ants for example. In the open flower the stamens gradually become longer and attain a length of 8 mm. outside of the tube, while the style is 1 mm. shorter. At first only the style and the 2 stamens next to the lower lip protrude from the newly opened flower; the style bends outwardly and takes up a position in the middle between the 2 stamens, which are divergent. The stigma is receptive from the time on it escapes from the bud, while the 2 neighboring anthers do not open as early. This slight degree of proterogyny is sufficient to insure cross-fertilization in many cases, as the flowers attract a numerous set of visitors. The 3 remaining stamens are usually erect, their anthers do not begin to dehisce until the 2 others have shed their pollen. The style retains its first position for about a day, and then it moves towards the upper lip; in the new position the stigma may touch an anther of one of the erect stamens and become self-fertliized, in case fertilization has not been accomplished previously. As the recurved lower lip is placed out of the way of the visitors, the latter are likely to alight on the protruding stamens and style. This is a contrivance favoring cross-fertilization, especially in the younger flowers, as long as the style is directed outwardly. The flowers emit a faint odor. In the following I give a list of the visitors observed.

A. Bees.

Apidae: (1) *Apis mellifica, L.* ☿ s.; (2) *Bombus americanorum, F.* ♀ ☿, s.; (3) *B. consimilis, Cr.* ♀ ☿, s.; (4) *B. edwardsii, Cr.* ♀, s.; (5) *B. pennsylvanicus, De G.* ♀ ☿, s.; (6) *B. ternarius, Say* ♀, s.; (7) *B. virginicus, Oliv.* ♀, s.; (8) *Ceratina dupla, Say* ♂, ♀, s. and cp.; (9) *Osmia albiventris, Cr.* ♀, s.; (10) *O. atriventris, Cr.* ♀, s.; Andrenidae: (11) *Halictus coriaceus, Sm.* ♀, s.; (12) *H. fasciatus, Nyl.* ♀, s. and cp.; (13) *H. similis, Sm.* ♀, s. and cp.; (14) *Agapostemon radiatus, Say* ♀, s.; (15) *Andrena vicina, Sm.* ♀, s.;

B. Birds.

(16) *Trochilus colubris, L.* s.

In regard to its floral structure, *Lonicera oblongifolia, L.*

resembles *L. nigra, L.*, a honeysuckle growing in the Alps, an account of which has been furnished by Hermann Mueller (12).

Lonicera Sullivantii, Gray. Sullivant's Honeysuckle.

It is the commonest species in this part of the country and the latest to appear, blooming from June 5 to July 2. Robertson (13) has published an account of its fertilization and reported the visits of 3 bees, 1 Syrphid-fly and the hummingbird. This is a bumble-bee flower, like *L. dioica,* resembling the latter in many respects and blooming directly after it. In this species too the flowers are in whorls at the ends of the branches and are mostly in a horizontal position. They are whitish-yellow, but later on change to purplish. The formation of a lower and an upper lip is much the same as in L. dioica. Flowers from our neighborhood present the following dimensions: The corolla tube has a length of 14 mm., a width of 4 mm. at its mouth and of 2 mm. in its narrowest portion, immediately above the nectar-secreting gibossity. Nectar is also secreted in small drops along the lower wall of the tube as far as the middle of the latter, and this accounts for the rather frequent visits of short-tongued bees, which are able to crawl into the mouth of the tube and reach these drops of honey. At the bottom of the tube honey accumulates to a height of 2 or 3 mm. and this can of course be obtained by long-tongued visitors only, such as bumble-bees, hawk-moths and hummingbirds. The stigma is 10 mm. from the mouth of the tube and about 1 mm. in advance of the anthers. As in L. dioica the flowers are homogamous or slightly proterogynous. I have repeatedly seen the style, bearing the receptive stigma protrude for a length of 3 to 5 mm. from the bud previous to its opening These cases furnish an excellent opportunity for cross-fertilization, which is brought about by bees crawling over the inflorescence, with pollen attached to the underside of their bodies. On sunny days the flowers may be observed opening at all times of the day.

The following is a list of the visitors as taken during the last two seasons:

A. Bees.

Apidae: (1) *Apis mellifica, L.* ☿, s.; (2) *Bombus americanorum, F.* ♀, s.; (3) *B. consimilis, Cr.* ♀ ☿, s.; (4) *B. edwardsii, Cr.* ♀, s.; (5) *Clisodon terminalis, Cr.* ♂ ♀, s.; (6) *Anthophora abrupta, Say.* ♂, s.; (7) *Synhalonia atriventris, Sm.* ♀,

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12. H. Mueller. Alpenblumen, ihre Befruchtung, etc., p. 394-395.
13. C. Robertson. Flowers and Insects. XVIII. Bot. Gaz. Vol. XXV. (1898) p. 242.

s. and cp.; (8) *Ceratina dupla, Say.* ♀, s.; (9) *Megachile relativa, Cr.* ♀, s. and cp.; Andrenidae: (10) *Halictus coriaceus, Sm.* ♀, cp.; (11) *H. forbesii, Rob.* ♀, cp.; (12) *H. similis, Sm.* ♀, s. and cp.; (13) *Augochlora vividula Sm.* ♀, cp.; (14) *Agapostemon radiatus, Say.* ♀, s.

B. Flies.

Syrphidae: (15) *Mesogramma marginata, Say,* fp.; (16) *Syrphus xanthostomus, Will.* fp.

C. Butterflies and Hawk-Moths.

Rhopalocera: (17) *Atrytone zabulon, Boisd.-Lec.*, s.; Heterocera: (18) *Hemaris diffinis, Boisd.*, s.

D. Birds.

(19) *Trochilus colubris, L.*, s.

As has been stated above, *Lonicera Sullivantii* is adapted to bumble-bees; 2 species of the latter: *Bombus americanorum* and *B. edwardsii* are the most frequent among the visitors, as I have often observed. The visits of the smaller bees are of slight significance. If they appear on the newly opened flowers, as long as the stamens and style are short and close together, they may, while collecting pollen at the same time touch the stigma and cause either self- or cross-fertilization. The hawk-moth: *Hemaris diffinis* and the hummingbird may be of benefit to the flowers, while the pollen-eating Syrphid-flies can render no services whatever.

REVIEW: Our species of Lonicera, which have been considered in the foregoing, are all adapted to bees. They differ from each other mainly in the length of their corolla tubes, *L. oblongifolia* having the shortest tube, with a length of 4 mm. only, while the longest tube, that of *L. Sullivantii* attains a length of 14 mm. in our locality, and of even 18 mm. in Southern Illinois, as reported by Robertson. The length of the stamens and style is also of much importance, as those of our honeysuckles with long and widely divergent stamens and a long style can hardly be efficiently visited by the small-bodied bees, but have to rely to a certain extent on the cooperation of bumble-bees.

The following table refers to the number of visitors, as observed on our 5 species of Lonicera in different localities:

		Bumble-Bees.	Other Bees.	Syrphid-Flies	Butterflies & Hawk-Moths.	Hummingbird	Total.
Bee-Flowers.							
L. oblongifolia	Milwaukee, Wis	6	9			1	16
L. tatarica (14)	Germany		3	1			4
L. tatarica	Milwaukee, Wis	5	6	1	1	1	14
Bumble-Bee Flowers.							
L. ciliata (15)	Maine	1	?				?
L. ciliata	Milwaukee, Wis		6				6
L. dioica	Milwaukee, Wis	2	7			1	10
L. Sullivantii (16)	Southern Illinois	2	1	1		1	5
L. Sullivantii	Milwaukee, Wis	3	11	2	2	1	19

A glance at the figures of this table, furnishes evidence of the important part, taken by bees in the fertilization of these flowers, as the visits recorded above give an average of 83% in favor of the bees. The species adapted to the smaller bees are also frequently visited by bumble-bees, and on the other hand the smaller bees pay much attention to the bumble-bee-flowers. The absence of wasps from these flowers is worthy ot mention; I have not witnessed the visit of a single wasp to any of these honeysuckles. The latter seem to be rather attractive to the hummingbird, this visitor having been observed on all our species, with the exception of *L. ciliata,* the first of our honeysuckles to appear in spring.

NOTE—It affords me great pleasure to express my thanks to a number of gentlemen, wno have kindly aided me in various ways in connection with this paper: To Mr. J. A. Brandon, the treasurer of our society, who made the drawings of the flowers, reproduced on the accompanying plate; to Mr. Wm. H. Ashmead and Mr, D. W. Coquillett, both from the division of entomology of the Department of Agriculture, Washington, D. C., for the courteous help given me, in determining many of the hymenopterous and dipterous insects taken on the flowers.

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(14) H. Mueller, loc. cit., p. 364 and Weitere Beobachtungen, p. 235.

(15) John H. Lovell, loc. cit., p. 46.

(16) C. Robertson, loc. cit., p. 242.

The American Crocodile.

By GEO. A. WEST.

A desire to see the Everglade country of Florida more thoroughly than is possible to ordinary tourists, led to the formation of a party to spend a portion of the winter of 1892 there.

The party consisted of Prof. Carl E. Akeley, W. H. Ellsworth, Dr. E. W. Beebe and the writer. It gives me pleasure to acknowledge that it would have been impossible to accomplish much, had it not been for the cheerful and efficient aid which my companions rendered.

A true crocodile, *Crocodilus Americanus*, is found only in Florida, and from careful investigation, I am convinced inhabits not to exceed fifteen square miles of country. We found one colony of them living in Indian Creek, about six miles north of Miami, and others making their homes in two unnamed creeks, about half a mile apart, and extending back from Black Water Bay, four or five miles to the Everglades. Our native guides, who were familiar with every foot of Southern Florida, insisted that the crocodile lived in only these two locations and that no alligator existed within several miles of the abodes of these reptiles. We attributed this to the fact that the crocodile is much larger, more active and savage than the alligator, and doubtless wages a war of extermination against him.

We found the American crocodile inhabiting nothing but brackish water; not marshy streams of fresh water and mud banks, as they are claimed to do by most writers. Their homes were in clear water; their sunning beds on the highest and dryest banks they could find, and every particle of earth was invariably cleared away, leaving the white, clean coral for a bed. Their places of retreat were caves in the coral; never muddy bottoms like those of the alligator. The fact that they do not hibernate there may account for their having cleaner habits than is attributed to other species of the same genus.

Their exceeding wildness made it nearly impossible to get within rifle shot while in their sunning beds, and despite the fact that most writers credit these reptiles with depending principally on their sense of hearing and smell, I am convinced that their keenness of sight is equal to that of any animal. Observations at short range were had by the writer from the branches of a convenient tree, located on the bank of Caesar's pool, a clear, deep spring of a quarter of an acre in extent, with outlet into Indian Creek, through which frequent visits were made by the reptiles. They would occasionally come in, make a circuit of the pool, and invariably halt opposite my point of observation, although I was exceedingly careful not to move, they would at once fasten their eyes on me, remaining in the same position for an hour at a time, only occasionally winking and working the valves of their ears and nose. One visitor was an old female with two young, each probably 16 inches long. As she passed, the old fellow opposite me made a quick lunge at one of the little fellows; instantly the female was upon him and a terrible struggle followed, resulting in his being driven out of the pool. The mother then swam around and around, apparently hunting for her young, seemingly in great distress, and plainly indicating considerable natural affection for her offspring.

Not being able to induce any one of my visitors to present enough of his head above the water to offer a fair rifle shot, a wounded pelican was obtained and hung from an overhanging limb, within two feet of the water, but Mr. Crocodile could not be induced to touch it. The bird was then allowed to swim around the pool, and although five crocodiles were in sight, none seemed to have a taste for fowl. One, however, made a lightning-like dash, catching a fish of the drum variety, weighing about three pounds.

The second day's watch resulted in my getting a successful shot at one, and later we obtained several specimens, one of which was a badly scarred and tailless veteran, twelve feet in length. We occasionally located one in the bottom of a stream and found it possible to row our boats over it, without its moving, provided we did not look down, but the moment our eyes were turned toward the reptile, it would dart away with lightning-like speed.

Three were captured by means of "graining," that is, striking them with a two-tined spear in the back of the neck. When one was struck it would dash up or down the stream a short distance, towing our boat after it, then stop and roil the water; we would then row our boat over the place and carefully place a wire noose over its nose, when it would at once feign death and allow us to take it into our boat with impunity. Contrary to the common idea, we found that they did not use their tails for striking, but invariably struck a side blow with their long and bony heads. When attacked it would hiss like a serpent and emit a strong odor of musk from glands located in the lower part of its jaw. They are of a drab or lead color on the back and sides, shading into a white below, and we judge do not grow to exceed sixteen feet in length.

We found the dermal armor quite deficient of bony plates, so far as the neck was concerned, thus accounting for more freedom of motion of the head than is generally the case with this family. As is common to all crocodiles, the toes, of which there are five on each of the anterior limbs and four on the posterior pair, are considerably webbed, while the three inner ones are provided with claws, the hind limbs being handsomely fringed.

The tongue seemed to be attached all around to the bottom of the mouth; the lungs confined to the thorax; the heart four valved, the venal and arterial blood mingling outside the heart. Traces of a diaphram were very pronouncd in one specimen, thus showing an approach in organization to the warmer blooded animals, and beyond doubt placing them among the highest order of living reptiles. The teeth are distinctly socketed, with exactly thirty-six on upper jaw and thirty on lower, the two second teeth of the lower jaw, when the mouth is closed, projecting through holes in the upper jaw, and the tenth tooth of the upper jaw being by far the largest. The fourth, or canine teeth, so-called, of the lower jaw, are the largest on that jaw. Each tooth contained from one to four smaller teeth, one fitting closely over the other. The brain cavity was about double the size of that of the alligator. The stomachs of two which we examined contained only fragments of fish and turtle. The writer concluded that the American Crocodile is particular with his diet, never eating dead things when he can kill his own food, and that he does not take food to his cave and let it putrify, as many writers suggest; possibly, however, because of the abundance of food in his American home.

We heard none make a noise of any kind, excepting the hiss common to reptiles, and while we "grunted" out alligators from their muddy retreats with ease, our efforts in this direction with the crocodile were futile.

Additions to the Flora of Milwaukee County.

By W. J. BENNETTS.

A Second Supplement to W. M. Wheeler's "Flora of Milwaukee County."

In 1888, a list of the flowering plants and ferns of Milwaukee county by W. M. Wheeler, then curator of the Milwaukee Public Museum, was published in the transactions of this society. It contained the names of 691 species and was followed in 1889 by a supplementary list containing 58 additional names.

Since that date no work appears to have been done in the way of cataloguing our Milwaukee wild plants until the past year, 1899, when the botanical section of the Milwaukee Natural History Society inaugurated among its members what might be termed a "co-operative card catalogue" system of collecting and recording facts relating to our local flora. As, however, it will be several years before sufficient data can in this way be accumulated to warrant the publishing of the elaborate report this system appears to render possible, it has been thought best to publish at intervals the names of such additions to our flora as have become known since the publication of the previous list.

The list which follows contains 82 species, bringing the number thus far recorded for Milwaukee county up to 831. In compiling it, the writer has had the cheerful co-operation of three of our local botanists, Dr. S. Graenicher, and Messrs. Ernest Bruncken and Philip Wells. Dr. Graenicher has contributed the following 10 numbers of the list: 769, 770, 778, 780, 800, 804, 820, 823, 826, 831. Mr. Wells furnished 14 names, viz. numbers 753, 754, 764, 772, 776, 781, 788, 794, 796, 802, 803, 821, 828, 830; while the following 11 were supplied by Mr. Bruncken: numbers 760, 763, 779, 799, 806, 808, 809, 810, 811, 812, 813. Of the remaining 47 numbers 45 were supplied by the writer and 2 by P. H. Dernehl.

An examination of this list of plants shows that they admit of being arranged into 4 classes. In the first class can be placed those species that have been introduced from Europe or Asia. Some of these are troublesome weeds like the Russian Thistle *Salsola Targus, L.*), the remainder are in general plants that have escaped from gardens or from cultivated fields. This group contains 21 species as follows: *Anagallis arvensis, L., Aquilegia vulgaris, L., Bromus hordeaceus, L., Crateagus Oxyacantha, L., Echium vulgare, L., Eragrostis*

major, Host., Genista tinctoria, L., Lepidium ruderale, L., Lonicera Japonica, Lonicera Tatarica, L., Ranunculus acris, L., Rhamnus cathartica L., Rosa rubiginosa, L., Salix babylonica, L., Salix pentandra, Salsola Tragus, L., Sisymbrium altissimum, L., Silene vulgaris, Garcke, Trifolium dubium, Sibth., T. agrarium L., and T. incarnation L.

A second class may be formed of 5 American species that are eastern in their range, never having been reported as far as the writer knows any farther west than the state of Indiana, so that their occurrence here is equivalent to an extension of the western limit of their range. These species are: *Aster Shortii, Hook., Aster Lowrieanus, Porter., Bromus hordeaceus, L., Conopholis Americana, Wallr., and Leptamnium Virginianum Raf.*

Six species have come to us from the west and as they have all been found growing chiefly, if not exclusively, along the railway tracks of the city, their seeds were no doubt first introduced here by railway trains from the states west of us. These species are: *Gaertneria acanthicarpa, Britton, Helianthus scaberrimus, Ell., Linum Lewisii, Pursh., Ratibida columnaris, Don., Solanum rostratum, Dunal. and S. triflorum Nutt.* Two European species, *Sisymbrium altissimum, L.*, and *Salsola Tragus, L.*, may also be placed in this class as they first established themselves in the Western states and are now extending their range eastward.

With the exception of 2 tropical species, *Datura Metel, L.*, and *Ipomoea purpurea, Roth.*, which have escaped from gardens, the 50 species remaining are native plants, whose range overlaps the area considered in the list, and which one might therefore expect to occur in our county wherever the natural conditions are suited to the habits of the species.

The nomenclature followed is that of Britton & Brown's "Illustrated Flora of the Northern United States and Canada," edition of 1898. In a few cases, however, the more familiar names of Gray's Manual have been added in parenthesis.

List of Species.

750 **Æsculus glabra, Willd. Ohio Buckeye. A shade tree along Hanover Street on the South Side.**

751 **Alnus Alnobetula, K. Koch. Mountain Alder. Near Oakwood station in township of Oak Creek.**

752 **Amelanchier rotundifolia, Roem. Round-leaved June-berry. Occasional along the east bank of the Milwaukee River.**

753 **Anagallis arvensis, L. Scarlet Pimpernell. By the roadside on Hawley Road, south of National Ave.**

754 Aplectrum spicatum, B. S. P. Adam and Eve Orchid. Koeffler's Woods, Wauwatosa; Reynold's Woods, Greenfield.

755 Aquilegia vulgaris, L. European Columbine. Has been found along the Milwaukee River (P. H. Dernehl).

756 Asclepias tuberosa, L. Butterfly Weed. I found a number of specimens of this milkweed in 1895 in an open space in a woods a mile and a half south of South Milwaukee.

757 Aster azureus, Lindl. Sky Blue Aster. In the Menomonee Valley and along the Milwaukee River.

758 Aster Shortii, Hook. With the last, in the Menomonee Valley and in the northwestern part of the county.

759 Aster Lowrieanus, Porter. Lowrie's Aster. Common around Milwaukee along with *A. cordifolius* which it much resembles.

760 Betula lutea, Mich. f. Yellow Birch. Two places in Town of Wauwatosa.

761 Bromus hordeaceus, L. Soft Chess. Menomonee Valley and elsewhere.

762 Carex hystricina, Muhl. Porcupine Sedge. Whitefish Bay and Menomonee Valley.

763 Celtis occidentalis L. Hackberry. Menomonee Valley and Mud Creek.

764 Chenopodium Boscianum, Moq. Bosc's Goosefoot. Vacant lots near Coldspring show grounds.

765 Conopholis Americana, Wallr. Squaw Root. On the east bank of Milwaukee River near Mineral Spring Park, also at South Milwaukee.

766 Crataegus Oxyacantha, L. Hawthorn. Along fences within the city limits—escaped from gardens.

767 Crataegus mollis, Scheele. Not rare throughout the county.

768 Cyperus esculentus L. Yellow Nut Grass. Milwaukee River near the Cement Mills.

769 Cynoglossum Virginicum, L. Wild Comfrey. In woods at Bay View.

770 Dasystoma (Gerardia) grandiflora, Wood. Bay View, in open woods.

771 Datura Metel, L. In waste places within the city—an escape from gardens.

772 Echium vulgare, L. Viper's Bugloss. Along Northwestern R. R. tracks opposite Mineral Spring Park.

773 Eleocharis palustris glaucescens, Gray. Near the Cement Works on the Milwaukee River.

774 Epilobium Hornemanni, Reichenb. Near the Milwaukee River in S. E. quarter of section 18, Township of Milwaukee.

775 Eragrostis major, Host. Menomonee Valley near Sixth Street Viaduct.

776 Gaertneria acanthicarpa, Britton. Hooker's Gaertneria. Along the St. Paul tracks near West Milwaukee.

777 Gaultheria procumbens L. Creeping wintergreen. In a woods in N. E. part of the county (P. H. Dernehl).

778 Gaura biennis L. Numerous in the Menomonee Valley near the Grant Marble Works.

779 Genista tinctoria, L. Base Broom. At Juneau Park. (E. Bruncken.)

780 Geranium Carolinianum, L. Carolina Crane's Bill. A single specimen found in a dry pasture south of National Ave. at Silver City. (Dr. S. Graenicher.)

781 Gyrostachys (Spiranthes) cernua, Kuntz. Nodding Ladies' Tresses. In a wet meadow southwest of the city near the Janesville Road. (P. Wells.)

782 Helianthus scaberrimus, Ell. Near the Northwestern R. R. tracks foot of Florida Street.

783 Heteranthera dubia, MacM. Western Star Grass. In the Milwaukee River near the Cement Works.

784 Impatiens aurea Muhl. Pale Touch-me-not. Common in Perine's Woods on the Milwaukee River, Section 18, Town of Milwaukee.

785 Impomoea purpurea Roth. Morning Glory. Escaped from gardens and growing along fences and in waste places within the city limits.

786 Lactuca Scariola L. Prickly Lettuce. A troublesome weed everywhere.

787 Lepidium ruderale L. Narrow-leaved Pepper Grass. Waste places in the city.

788 Leptamnium (Epiphegus) Virginianum, Raf. Beech Drops. Cancer Root. In a grove north of the city limits near Oakland Avenue.

789 Lithospermum latifolium, Michx. American Gromwell. In a woods near Lisbon Road, Town of Wauwatosa.

790 Lilium superbum L. Turk's Cap Lily. In a woods near Whitefish Bay—rare.

791 Linum Lewissi, Pursh. I found this species or the *L. perenne* of Europe for two successive years growing in a vacant lot on the East Side.

792 Lonicera Japonica. Thunb. Escaped from cultivation in a few places in and near the city.

793 Lonicera Tatarica, L. Tartarian Bush Honeysuckle. Common in the vicinity of Milwaukee.

794 Œnothera rhombipetala, Nutt. Rhombic Evening Primrose. Northwestern R. R. tracks near Juneau Park.

795 Panicum Porterianum, Nash. Porter's Panicum. Banks of Milwaukee River near Mineral Spring Park, also in Wauwatosa.

796 Potentilla arguta, Pursh. Tall Cinquefoil. In Town of Milwaukee north of the city.

797 Polygonum Hartwrightii, Gray. In a swamp in woods west of Soldiers' Home grounds.

798 Polygonum punctatum, Ell. Water Smart-weed. In the Menomonee Valley near the Wells Street viaduct.

799 Quercus velutina, Lam. (Q tinctoria, Bart.) Quercitron. Menomonee Valley.

800 Ranunculus Pennsylvanicus, L. Bristly Buttercup. Near a tamerack swamp by New Coeln.

801 Ranunculus acris, L. Tall Buttercup. Menomonee Valley and waste places on the West Side.

802 Ratibida columnaris, (Sims.) D. Don. Prairie Cone Flower. Wauwatosa near the pumping station of garbage plant.

803 Rhamnus cathartica, L. Buckthorn. Escaped from hedges near the Lisbon road in Township of Wauwatosa.

804 Ribes rubrum, L. Red Currant. Dr. S. Graenicher has found this species in the Menomonee Valley near the Wells Street viaduct also in a woods west of Soldiers' Home.

805 Rosa rubiginosa, L. Sweetbrier. I have found this rose growing in a meadow along Oak Creek, also along fences near the Lisbon Road.

806 Salix Bebbiana, Sarg. Bebb's Willow. Occasional throughout the county.

807 Salix candida, Fluegge. Hoary Willow. In a former tamerack—S. W. quarter of Section 22, Town of Oak Creek.

808 Salix Babylonica, L. Weeping Willow. Occasionally this species or some of its varieties is found growing wild.

809 Salix discolor, Muhl. Glaucous Willow. Our earliest blossoming willow, common in moist places throughtout the county.

810 Salix nigra, Marsh. Black Willow. One of our commonest willows.

811 Salix nigra falcata (Pursh), Torr. Occasional throughout the county.

812 Salix amygdaloides, Anders. Peach-leaved Willow. Very common in swamps.

813 Salix pentandra. Occasionally found growing wild.

814 Sambucus pubens, Michx. Red Elder. In the southwest part of the county—rare.

815 Salsola Tragus, L. Russian Thistle. Rapidly spreading and monopolizing waste places and vacant lots around the city especially where the sod has been removed.

816 Scirpus Americanus, Pers. Perine's Woods on the Milwaukee River.

817 Sisymbrium altissimum, L. A common weed in some parts of the city.

818 Silene vulgaris (Moench), Garcke. Bladder Campion. I found a few plants growing along the Janesville Road about three miles from the city in 1897.

819 Silphium perfoliatum, L. Indian Cup . Common along the Mukwonago Road about a mile S. W. of North Greenfield.

820 Smilax ecirrhata, S. Wats. Upright Smilax. Frequent throughout the county.

821 Solanum rostratum, Dunal. Sand Bur. Waste places and Railway tracks—occasional.

822 Solanum triflorum, Nutt. Cut-leaved Nightshade. Along Railway tracks in the Menomonee Valley near the Sixth Street viaduct.

823 Synosma (Cacalia) suaveolens (L) Raf. Sweet Scented Indian Plantain. East bank of Milwaukee River near Mineral Spring Park.

824 Symphoricarpos occidentalis, Hook. Wolfberry. In the Menomonee Valley.

825 Tofieldia glutinosa, (Michx.) Pers. Lake bluffs from Whitefish Bay northward, also reported from south of the city.

826 Trillium nivale Riddell. Snow Trillium. Dr. Graenicher, who has observed this species growing along the Menomonee river just west of Wauwatosa declares it to be our earliest entomophilous flower, blooming some years as early as April 19th.

827 Trillium erectum, L. Common throughout the county especially north and west.

828 Trifolium dubium, Sibth. Least Hop Clover. North Greenfield and fifteenth ward.

829 Trifolium agrarium, L. Hop Clover. I have found it in the Menomonee Valley. It has been found near Cudahy by C. E. Brown.

830 Trifolium incarnatum, L. Italian or Napoleon's Clover. Banks of Honey Creek in Wauwatosa.

831 Verbena stricta, Vent. Hoary Vervain. Along railway tracks west of Layton Park.

The Syrphidae of Milwaukee County.

By Dr. S. GRAENICHER.

Of all the insects visiting flowers in search of honey and pollen, none are more apt to attract the attention of the observer, than the flies belonging to the family of Syrphidae. They display an elegance of form and markings, and a gracefulness in their movements, when on the wing, which rarely fail to win our admiration. As agents in transferring pollen from one flower to another, and thereby effecting cross-fertilization, they are of the utmost importance. Some of the species are represented by great numbers of individuals, and may, in our latitude, be observed as flower-visitors from the beginning of April to the later part of October. The species which never resort to flowers are few in number.

During the past five years, while studying the mutual relations of flowers and insects, I have become acquainted with 64 species of Syrphidae, occurring within the limits of Milwaukee county, few of which have hitherto been recorded from the State of Wisconsin. In the following I present a list of these species, and accompany the name of each with a few remarks, pertaining to the time of flight, the geographical distribution of the species and the flowers visited by the insect at the date of capture referred to:

1. Microdon tristis, Loew. Rare. 3 ♂ *specimens taken in June, flying along dry, sunny paths, near the ground. I have never observed this species as a flower-visitor.
   Previously reported for the Atlantic States, Oregon and the Mackenzie River.
2. Paragus bicolor. Fabr. Not common. From May (on flowers of *Mitella diphylla, L.*) to September (on flowers of *Aster lateriflorus (L.) Britt).* Occurs in Europe and North America. Has been recorded from Connecticut, Washington, Montana southward to New Mexico, and also from Illinois.
3. Paragus tibialis, Fallen. Not commoner than the preceding. Fron May (on flowers of *Veronica serpyllifolia, L.*) to October (on flowers of *Eupatorium ageratoides, L.*).
   Inhabits Europe and North America and has been recorded from the New England States, California, New Mexico and Illinois.

(*) ♂ Male ♀ Female

4. Pipiza femoralis, Loew. Rare. 1 ♂ and 1 ♀ taken in May on the flowers of *Ribes cynosbati, L.*

   Previously recorded from Pennsylvania and Illinois.

5. Pipiza pistica, Will. Rare. 1 ♂ and 2 ♀ taken in May and September. One of these specimens was obtained from the flowers of *Agastache scrophulariaefolia,* (*Willd.*) *Kuntze,* and another one from the flowers of *Solidago Canadensis, L.*

   Described from 2 ♀ specimens, captured in Connecticut and also recorded from Illinois.

6. Chrysogaster pulchella, Will. Rare. 1 ♀ taken in June on the flowers of *Angelica atropurpurea, L.*

   Previously recorded from the New England States and Canada.

7. Chrysogaster nitida, Wied. Although not common, it is the species of Chrysogaster generally observed in our neighborhood. From June (on umbels of *Thaspium trifoliatum aureum, (Nutt.) Britt.).* to October (on flowers of *Hamamelis Virginiana, L.*).

   Occurs in South America and North America and has been recorded from the Atlantic States, Illinois and Kansas.

8. Chrysogaster pictipennis, Loew. Rare. From May (on catkins of *Salix lucida, Muhl.*) to July (on flowers of *Solidago serotina, Ait.*).

   Has been recorded from the Atlantic States, Illinois and Nebraska.

9. Chilosia cyanescens, Loew. Not common. 7 ♂ specimens and a single ♀ taken in May and June on the flowers of *Uvularia grandiflora, Smith.* and *Caltha palustris, L.,* mostly on the latter.

   Previously reported for Connecticut, New Hampshire and Illinois.

10. Melanostoma obscurum, Say. Not rare. From April (on catkins of *Salix discolor, Muhl.*) to October (on flowers of *Aster cordifolius, L.*)

    Has been recorded from the Atlantic States and Illinois.

11. Melanostoma mellinum, L. Rarer than the preceding. Has been captured in April (on catkins of *Salix discolor, Muhl.*) and May (on flowers of *Valeriana edulis, Nutt.*)

    Inhabits Europe and North America and has been recorded from the Atlantic and Pacific States, Kansas and Illinois.

12. Platychirus quadratus, Say. A common species, occurring from May (on flowers of *Saxifraga Pennsylvanica, L.*) to August (on umbels of *Sium cicutaefolium, Gmelin*).

    Previously reported for the Eastern, Middle and Pacific States.

13. Platychirus hyperboreus, Staeg. Not common. From July to September, preferably on the flowers of umbelliferous plants (*Oxypolis rigidus, (L.) Britt.*, and *Conioselinum Chinense (L.) B. S. P.*)

    Has been reported for the Atlantic States, Illinois Colorado and for Greenland.

14. Platychirus peltatus, Meig. Rare. 2 ♀ specimens taken in June.

    Inhabits Europe and North America. Has been reported for a few Atlantic States and Alaska.

15. Syrphus arcuatus, Fallen. Rare. 1 ♀ taken in September.

    Occurs in Europe and North America and has been observed throughout the northern part of the United States, from the Atlantic to the Pacific coast, extending its range southward as far as Colorado and northward to Hudson's Bay Territory and Nova Scotia.

16. Syrphus ribesii, L. Very common throughout the season, from April (on catkins of *Salix discolor, Muhl.*) to October (on flowers of *Hamamelis Virginiana, L.*)

    Inhabits Europe and North America, from the Atlantic to the Pacific States, south to Arizona, north to Canada.

17. Syrphus torvus, O. S. Not common. Taken in September and October on flowers of *Aster laevis, L.*

    Inhabits Europe, North America and Siberia. Has been recorded from various points of this continent, from the Atlantic to the Pacific coast, south to Colorado and north to Greenland.

18. Syrphus lesueurii, Macq. Rare. A single ♂ specimen captured in June on the umbels of *Cicuta maculata, L.*

    Previously recorded from the New England States, Washington and Alaska.

19. Syrphus americanus, Wied. An abundant species throughout the season, from April (on catkins of *Salix discolor, Muhl.*) to October (on flowers of *Hamamelis Virginiana, L.*)

    Has been recorded from the Atlantic States to Montana, from Canada and Texas.

20. Syrphus umbellatarum, O. S. Rare. Taken in August visiting the flowers of 2 species of Umbelliferae (*Oxypolis rigidus, (L.) Britt.,* and *Conioselinum Chinense (L.) B. S. P.*)

    Previously reported for New Hampshire, Arizona and Alaska.

21. Syrphus xanthostomus, Will. Rare. 1 ♂ and 1 ♀ the latter taken in June on the flowers of *Lonicera Sullivantii, Gray.*

    Has been previously recorded from Pennsylvania and Ohio.

22. Didea fasciata fuscipes, Loew. Not common. From June (on umbels of *Angelica atropurpula, L.*) to August (on umbels of *Oxypolis rigidus, (L.) Britt.*).

    Reported for Connecticut, Pennsylvania, Ohio and Illinois.

23. Xanthogramma flavipes, Loew. Very rare. A single ♂ spcimen captured in May.

    Previously reported for 3 Atlantic States.

24. Allograpta obliqua, Say. A common species, from May (on umbels of *Thaspium trifoliatum aureum, (Nutt.) Britt.*) to October (on flowers of *Hamamelis Virginiana, L.*)

    An inhabitant of North and South America (Argentine Republic). Recorded from different parts of the United States, from the Atlantic to the Pacific Ocean.

25. Mesogramma (Mesograpta) polita, Say. Not rare, flying in autumn. Taken in September (on umbels of *Sium cicutaefolium, Gmelin.*) and October (on flowers of *Aster cordifolius, L.*)

    Recorded from several states of the Atlantic coast, from Illinois and Kansas and from Cuba.

26. Mesogramma marginata, Say. Abundant from May (on flowers of *Sanguinaria Canadensis, L.*) to October (on flowers of *Aster laevis, L.*)

    Occurs throughout the northern part of the United States, from the Atlantic to the Pacific coast, and has been reported for Florida in the South.

27. Mesogramma geminata, Say. Abundant throughout the season, from April (on catkins of *Salix discolor, Muhl.*) to October (on flowers of *Hamamelis Virginiana, L.*)

    Inhabits South and North America. Has been recorded from the Atlantic and Pacific States and from Illinois.

28. Sphaerophoria cylindrica, Say. Abundant from May (on flowers of *Mitella diphylla, L.*) to October (on flowers of *Hamamelis Virginiana, L.*)

Previously recorded from the New England States, Illinois, Minnesota and Washington, as also from Canada and Nova Scotia.

29. Neoascia globosa, Walk. Rare. A few specimens taken in May (on flowers of *Amelanchier Canadensis, (L.) Medic.* and June (on flowers of *Unifolium Canadense, (Desf.) Greene*).

Has been recorded from the New England States and Oregon.

30. Neoascia distincta, Will. This is a very rare species. The only specimen in my collection is a ♀, captured in May.

This species was described from 2 ♀ specimens collected in Massachusetts and has not, to my knowledge, been recorded from any other part of the United States.

31. Baccha clavata, Fabr. (B. Babista, Walk.) Not frequent. From June (on umbels of *Thaspium trifoliatum aureum, (Nutt.) Britt.*) to August (on flowers of *Verbena urticifolia, L.*)

This is a southern species and has been previously recorded from Mexico, Florida, Georgia, Arizona, California and Nebraska.

32. Baccha fuscipennis, Say. Commoner than the preceding, from June to August in shady woods. I have never seen this species on flowers.

It extends its range southward as far as San Domingo and Guadeloupe and has been reported for the New England States, Ohio, Illinois and Kansas.

33. Baccha aurinota, Harris. This is the rarest of our species of Baccha. 2 ♂ specimens were obtained by me 2 years ago in the first week in September, visiting the flowers of *Solidago Canadensis, L.;* an additional ♂ was taken last season, at the same time of the year by Mr. Paul Dernehl.

Previously recorded from Canada, a few Eastern States, Ohio and Indiana.

34. Rhingia nasica, Say. Rare. A single ♂ taken in August, visiting the flowers of *Impatiens biflora, Walt.* and 2 ♀ in October on flowers of *Polymnia Canadensis, L.*

Has been reported for the Atlantic States, Kentucky, Ohio, Indiana and Illinois.

35. Sericomyia militaris, Walk. Not frequent. I have observed this species in September, visiting the flowers of several species of Compositae, as for example *Aster puniceus, L.* and *Soildago caesia, L.*

Ranges northward as far as Nova Scotia and Hudson's Bay Territory, and has been recorded from a few Eastern States, Colorado and New Mexico.

36. Eristalis tenax, L. Abundant throughout the season, from April (on catkins of *Salix discolor, Muhl.*) to October (on flowers of *Hamamelis Virginiana, L.*)

Inhabits Europé, Africa, Asia, Japan and North America, and has been reported for many of the states.

37. Eristalis aeneus, Fabr. Not frequent, but occurring at all times of the season, from April (on catkins of *Salix discolor, Muhl.*)to October(on flowers of *Aster laevis, L.*)

Inhabits Europe, Africa, Syria and North America and has been reported for New York, Ohio and Illinois.

38. Eristalis dimidiatus, Wied. A very common species on flowers, from April (on catkins of *Salix discolor, Muhl.*) to September (on flowers of *Aster puniceus, L.*)

Has been previously recorded from the Eastern States to Ohio, Illinois and Kansas.

39. Eristalis meigenii, Wied. (E. brousi, Will.) Rather frequent, from April to October (on flowers of *Aster laevis, L.*)

This species has a wide range of distribution in this continent, going northward to Nova Scotia and Alaska, southward to South America; within the United States it has been recorded from the Eastern, Middle and Western States to Idaho.

40. Eristalis bastardi, Macq. Not common. From May (on flowers of *Prunus Americana, Marsh.*) to October (on flowers of *Aster laevis, L.*)

Occurs as far north as Nova Scotia and Labrador, and has been reported for the New England States, Ohio and Illinois.

41. Eristalis flavipes, Walk. Not common. From July (on flowers of *Solidago serotina, Ait.*) to October (on flowers of *Aster laevis, L.*)

Previously recorded from British Columbia, Washington, Minnesota, Illinois, Michigan, Ohio and the New England States.

42. Eristalis transversus, Wied. An abundant species, from May (on flowers of *Senecio palustris, (L.) Hook.*) to October (on flowers of *Hamamelis Virginiana, L.*).

An inhabitant of the Atlantic States, from Canada to Florida and also reported for Ohio and Illinois.

43. Eristalis vinetorum, Fabr. Very rare. 2 ♀ specimens captured, one in August on the flowers of *Solidago serotina, Ait.* and the other in September on the flowers of *Solidago Canadensis, L.*

This species extends southward to Cuba and Brazil and has otherwise been recorded from Mexico, a few Southern States, Illinois, Indiana and Pennsylvania.

44. Helophilus latifrons, Loew. Not as common as the next, for which it is easily mistaken. Captured in September on the flowers of *Aster laevis, L.*

Has been previously recorded from the Atlantic to the Pacific States and Texas.

45. Helophilus similis, Macq. Abundant, from April (on catkins of *Salix discolor, Muhl.*) to October (on flowers of *Aster cordifolius, L.*).

Reported for New England, Canada, Indiana, Illinois, Kansas and California.

46. Helophilus laetus, Loew. Not frequent. Taken in May (on flowers of *Vagnera stellata, (L.) Morong.*) and July (on umbels of *Pastinaca sativa, L.*)

Has been previously recorded from 2 Eastern States and Illinois, and is one of the few species, which has been formerly reported for Wisconsin.

47. Helophilus chrysostomus, Wied. Rare. From May (on flowers of *Vagnera stellata, (L.) Morong.*) to August (on flowers of *Alisma Plantago-aquatica, L.*)

Recorded from several Eastern States and Georgia.

48. Helophilus distinctus, Will. Very rare. I have so far taken only a single specimen of this species.

Previously reported for Connecticut, Pennsylvania and Virginia.

49. Helophilus conostomus, Will. Rare. Taken in June on flowers of *Symphoricarpos racemosus, Michx.* and July on flowers of *Carduus arvensis, (L.) Robs.*

Previously reported for the Atlantic States from Canada to New York and for Illinois.

50. Mallota posticata, Fabr. Not frequent. Captured in May and June (on flowers of *Unifolium Canadense* (*Desf.*) *Greene.*)

Occurs in the Atlantic States from Canada to Pennsylvania, and has also been recorded from Indiana.

51. Mallota cimbiciformis, Fallen. Not frequent. From June (on flowers of *Vagnera stellata,* (*L.*) *Morong.*) to July (on flowers of *Cicuta maculata, L.*)

Previously recorded from the Atlantic States (Canada to Georgia) and besides from Ohio, Illinois and Nebraska.

52. Triodonta curvipes, Wied. Rare. 7 ♂ specimens of this beautiful fly taken in July on the flowers of *Carduus arvensis,* (*L.*) *Robs.*

Has been reported for New England, Mexico, Colorado and California.

53. Tropidia quadrata, Say. A common species from May (on flowers of *Vagnera stellata,* (*L.*) *Morong.*) to August (on flowers of *Gerardia tennifolia, Vahl.*)

Has been recorded from the New England States, Canada and Nova Scotia in the East and Ohio, Illinois and Washington in the West.

54. Criorhina (Cynorhina) analis, Macq. Rare. 4 ♂ and 1 ♂ taken in May and June. None of these specimens were observed on flowers.

Reported for the Eastern States.

55. Criorhina (Somula) decora, Macq. Very rare. 1 ♂ specimen obtained in June.

Previously recorded from the Eastern and Middle States, as also from Illinois.

56. Crioprora cyanogaster, Loew. Rare. This is an early flying species. I have captured 1 ♂ and 2 ♀ specimens in April (on catkins of *Salix discolor, Muhl.*) and May (on flowers of *Solidago serotina, Ait.*)

Reported for Pennsylvania and Colorado.

57. Xylota ejuncida, Say. Not frequent. From May to July (on flowers of *Solidago serotina, Ait.*)

Occurs throughout the United States, from the Atlantic to the Pacific coast and from Canada to Alaska.

58. Xylota fraudulosa, Loew. Rarer than the preceding. 3 ♂ specimens taken in July.

This species has been observed throughout the northern part of the United States, from the Atlantic to the Pacific coast, and has been previously recorded from Wisconsin.

59. Xylota chalybea, Wied. Very rare. A single ♂ specimen taken in July, but not visiting flowers.

Reported for Pennsylvania, Virginia, Ohio and Illinois.

60. Syritta pipiens, L. A very common species throughout the season, from April (on catkins of *Salix discolor, Muhl.*) to October (on flowers of *Hamamelis Virginiana, L.*)

An inhabitant of Europe, Africa, Asia and North America, occurring all over the United States.

61. Spilomyia longicornis, Loew. Not frequent. Several specimens taken in August on flowers of *Eupatorium perfolitatum, L.* and *Solidago Canadensis, L.*

Has been recorded from the New England States, Texas, Ohio, Illinois and Kansas.

62. Spilomyia fusca, Loew. Rare. One ♂ specimen taken in July (on flowers of *Solidago serotina, Ait.*) and one ♀ taken in August (on flowers of *Eupatorium ageratoides, L.*)

Previously recorded from the Eastern States, from Canada to Georgia.

63. Spilomyia quadrifasciata, Say. Not frequent. From July (on flowers of *Solidago serotina, Ait.*) to September (on flowers of *Solidago Canadensis, L.*).

Reported for the Atlantic States, Illinois and Nebraska.

64. Milesia ornata, Fabr. Very rare. The only specimen I have seen, is a ♀ in Mr. F. Rauterberg's collection, which was captured by this gentleman two years ago in the neighborhood of Milwaukee.

This species has been recorded from the Eastern States, Ohio, Indiana, Illinois and Kansas and extends its range southward to Texas, Florida and Guadeloupe.

The 64 species of this list are distributed among 28 genera, and represent about one fifth of the number of species and one half of the number of genera enumerated and described in S. W. Williston's "Synopsis of the North American Syrphidae," published in 1886. Ten species of the list are common to this continent and Europe and three among these, viz.: *Eristalis tenax, L., Eristalis aeneus, Fabr.* and *Syritta pipiens,* L. have a very extended range of distribution, occurring in America, Europe, Asia and Africa. Among the species, which have never been observed outside of the American continent, the following five are inhabitants of North America and of South America besides: *Chrysogaster nitida, Wied, Allograpta obliqua, Say., Mesogramma geminata, Say., Eristalis meigenii, Wied.*, and *Eristalis vinetorum, Fabr.* Several of our species occur as far north as Alaska, Hudson's Bay Territory and even Greenland, as for example *Microdon tristis, Loew., Platychirus hyperboreus, Staeg., Syrphus arcuatus, Fall., Syrphus torvus, O. S., Syrphus lesueurii, Macq., Syrphus umbellatarum, O. S., Sericomyia militaris, Walk.* and *Xylota ejuncida, Say.*

The foregoing remarks on the geographical distribution of our species are based on the present standing of our knowledge of the subject. A careful study of the flies, belonging to this family, at different points of our continent, as well as of other continents, will certainly result in materially changing our views on the distribution of the species. Even in our own country, relatively little work has been done in this direction in most of the states, and this accounts for the fact, that several species, figuring on our list, have up to the present time been recorded only from regions, situated at a great distance from our locality. This is the case with *Microdon tristis, Loew.*, our two species of Neoascia, *Baccha clavata, Fabr., Helophilus distinctus, Will., Crioprora cyanogaster, Loew.*, and other species.

In determining the species, I have relied almost exclusively on Williston's "Synopsis of the N. Am. Syrphidae," referred to above, and have gained much information, regarding the geographical distribution of the species therefrom. Besides, I have had access to the following papers:

1. *Chas. Robertson.* Flowers and insects. Nos. I to XVIII, published in the Botanical Gazette. Vol. XIV, May 1889 to Vol. XXV, April 1898.

   Five additional papers of the same series appeared in Vol. V, Nos. 3 and 4, Vol. VI, Nos. 4 and 14 and Vol. VII, No. 6 of the Transactions of the Academy of Science of St. Louis.

2. *W. D. Hunter.* A contribution to the knowledge of North American Syrphidae. Paper No. I in the Canadian Entomologist, Vol. XXVIII, No. 4, April 1896; Paper No. II in the Canadian Entomologist, Vol. XXIX, No. 6, June 1897.

3. *Nathan Banks.* Some Syrphidae from Long Island. Journal of the New York Entomological Society, Vol. V, No. 1, March 1897.
4. *Oliver S. Westcott.* The distribution of some North American Syrphidae. Entomological News, Vol. VIII, No. 8, October 1897.
5. *C. H. Tyler Townsend.* Diptera from the White Sands, on the Tularosa plains of Southern New Mexico. Psyche, Vol. 8, No. 259, November 1897.
6. *James S. Hine.* Twenty-five species of Syrphidae, not previously reported for Ohio. Seventh Annual Report, Ohio State Academy of Science, Columbus, 1899.
7. *James G. Needham.* The fruiting of the blue flag (Iris versicolor, L.) The American Naturalist, Vol. XXXIV, No. 401, May 1900.

On the Forest Conditions in the Vicinity of Milwaukee.

By ERNEST BRUNCKEN.

The territory to which these notes refer comprises the townships Milwaukee and Wauwatosa, and the northern halves of the townships Lake and Greenfield. It is essentially a rolling plateau of glacial and postglacial clays, with occasional gravelly areas. Boulders of crystalline rocks are common in the glacial, and rare in the post-glacial deposits. The bed rock, formed of Niagara limestone, except in the northwestern portion, where it is Hamilton cement rock, shows very few outcrops, and those of very limited extent. Towards Lake Michigan, this plateau falls off very abruptly, forming almost vertical banks of an average height of fifty feet. In the town of Milwaukee there is a series of terraces of an average width of about 1,000 feet. The banks are in many places deeply dissected by ravines. The entire plateau is deeply eroded by the Milwaukee, Menomonee and Kinnickinnic rivers and numerous smaller water courses. Springs are common at the base of hills and bluffs. There are a number of small ponds, and in the depressions there are many marshy places, in some of which, during wet seasons, open water remains at the surface all summer.

This territory was originally covered with a heavy hardwood forest, with the exception of a marshy area, covered with sedges, at the mouth of the rivers. There was a large tamarack swamp in the southwest portion, and smaller ones in many other places. Settlement and the consequent clearing away of most of the forest took place between 50 and 60 years ago. Since then the forests of this neighborhood have consisted of isolated patches, the largest ones about 100 acres in extent, and ranging down to little groves of two and three acres. In the aggregate, there is a very respectable amount of wood land to be found in this region, but reliable statistics as to its acreage are not in existence. In this regard, as well as in regard to the condition in which these small forest tracts are found, the neighborhood of Milwaukee is typical of much of the settled and agricultural part of the state, and for this reason these notes may be of more than local interest.

The economic importance of these timber lots at the present moment is not very great. They are mostly parts of farms, and nearly all of them serve as pastures for farm cattle. They produce a considerable amount of fuel, both for domestic use and for consumption in various industrial establishments. A few trees are cut and sold for use as piles in the foundations of buildings, but no lumber has been manufactured from trees grown in this vicinity for a great many years. Under these circumstances the forest area of the region has been practically stationary for several decades. There has been some clearing for agricultural purposes in recent years, but the inroads made on the forest in this way are about counterbalanced by the reforestation that has taken place in the manner to be described below. An exception must be made with the areas formerly covered by tamarack. These swamps have nearly all been turned into meadow or tilled land, largely within the last twenty years. This is not to be regretted. For tamarack forests are of little value, while the soils on which they grow, when properly drained, or dried by natural processes, are among the most fertile of our agricultural lands.

Less satisfactory than the extent of these forests is the condition in which they are found at the present day. Being the property of so many different owners, who manage them with every conceivable variety and degree of care and skill, it is to be expected that their condition varies from lot to lot. Sometimes one can find startling contrasts between two neighboring wood lots, each but a few acres in extent. Such a contrast, for instance, may be seen in the northeast quarter of section 28, Wauwatosa. One of these lots consists of vigorous oaks and maples in the pole stage, with the usual proportion of the other species common to this region. There are numerous stumps of standards and veterans to show that not very many years ago a fine crop of wood was taken off the land. The crown cover is almost perfect; the floor is loose, with a considerable amount of leaf cover; there is no grass, and a moderate amount of underbrush and herbage. Numerous seedlings, largely of the very tolerant sugar maple, are showing a prosperous growth. About the only criticism one could make is that too many valueless trees, especially hop hornbeam, are allowed to take up space that ought to be occupied by their betters.

Divided from this well-kept tract by nothing but a rail fence is a startling contrast. Here reckless cutting has broken the canopy and let in an excessive amount of sunshine. As a result the floor is covered either with a matted carpet of grass, or hardened to the likeness of rock. Hardly a seedling can be found on the tract. In many places there is a wild tangle of brambles and useless shrubs. Not a few of the trees begin to be stagheaded and show other signs of decay, although they are still far from maturity.

The most common fault observed in the management of these wood lots is the excessive breaking of the crown cover. The most common result of this is that grasses occupy the floor, and make it almost impossible for tree seeds to sprout. Where the locality is not too dry, the injury may stop with the ceasing of reproduction. But elsewhere the remaining trees, especially elm and basswood, are usually doomed to gradual decay. Very often the proprietors are rather pleased if the forest floor becomes better pasturage for horses and cattle. They help this process along by removing all underbrush. Of course, where pasturage is really the most profitable use to which a wood lot can be put, nothing can be said against the practice. But the proprietor ought to realize that in this way he dooms his forest to extinction, unless once in a series of years he takes proper steps to regenerate it.

Where in a wood lot treated in this manner the trees allowed to remain have survived the transition period without injury, they are sometimes benefited if looked at as individuals, rather than as a forest. The abundant light they receive from all sides tends to cause an increased diameter growth in their boles, and a spreading and rounding of their crowns. This gives a very pleasing, park-like aspect to a number of such tracts. It reminds one of the "openings" in other parts of the state. Only, here the trees are mostly young, and do not present the picturesque gnarled appearance of the veteran oaks of the prairie "openings."

Generally speaking, a grass-covered floor is an entire check to the reproduction of a forest in this region. There are some places, however, (for instance, in a young wood with northern exposure, in the south half of section 27, Wauwatosa), where numerous seedlings of oak were observed in 1899 and 1900, notwithstanding a dense and long covering of grass. The seedlings of no species save oak were ever found by me in such localities. Next to a grassy floor, the poorest condition for the growth of seedlings seem to prevail in the places occasionally found (e. g. near Whitefish Bay) where the floor is occupied by *Amphicarpaca monoeca,* which allows no alien species to find a place in its dense carpet. Such weeds as goldenrod and sunflower, which are exceedingly common in many portions of this territory, seem to present no appreciable obstacle to the growth of tree seedlings. But the best conditions for the latter are found where herbage on the ground is entirely absent or confined to scattered patches. This state of things is rarely found in the smaller lots, but occassionally met with in portions of the larger timber tracts, such as that west of the Soldiers' Home.

The trees which constitute the forests of this vicinity are a mixture of hardwoods with the sugar maple, the white oak and the bass wood far out-numbering all other species. Other common trees of forestal value are the red oak, swamp white oak, burr oak, white ash, black ash, butternut, shell bark hickory and cherry. In a narrow strip along the lake shore the beech and the paper birch are of common occurrence. The elm is confined to the river bottoms and some particularly moist localities on the uplands. There are many other species which occur in such small numbers or such restricted localities that they are of little importance from a forestal standpoint, however interesting they may be to the student of plant distribution. Finally there are those small and inferior species, like hop hornbeam, blue beech, crab apple and others, which are far too common and aggressive to delight the forester.

Among the changes which have taken place in the forests of this region since the beginning of settlement the most important, next to the great diminution of forest area, is the disappearance of the old trees. The bulk of the trees composing the forests of the present day are young, rarely more than fifty years of age. Where a veteran is found, it has usually been spared by the axe simply because its wood was rotten or worthless. While trees of large size are therefore rare, the remaining stumps are evidence that all the common species are capable of growing to great dimensions in this region. It is impossible to collect data concerning the rate of growth, because no fellings on a large scale have been undertaken for a great many years, and are not likely to be undertaken for many years to come. The only one of the common indigenous species which seems to be incapable of large growth in the region appears to be the beech (1).

A species which was formerly common, but has almost entirely disappeared, is the black walnut. On the other hand there is some evidence that the two aspens, *Populus tremuloides* and *P. grandidentata*, are newcomers in this region. Hardly a profitable exchange! There is also considerable evidence for the belief that the oaks, and particularly white oak, are spreading at the expense of other species. There are many places, especially where the shade is very light, in which the only seedlings observable are those of oak. On the other hand, where the crown cover is dense, the seedlings of sugar maple are sometimes found to the exclusion of other and less tolerant species.

There are a number of areas which were denuded of their tree growth a number of years ago, but where the forest is re-establishing itself. These are mostly tracts that were used as

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(1.) See Bull. Wis. Nat'l. History Society, January 1900, p. 33.

pastures. The process of reforestation, which may be observed in all its stages in various localities, appears as follows: At first the sward of grasses is broken in such a manner as to allow non-gramineous herbs to establish themselves. The places so occupied afford an opportunity for the various shrubs that form the underbrush in this region, such as hazel, witch hazel, prickly ash, and many others. After the lapse of a number of years, these shrubs may cover the entire field, forming a more or less interrupted thicket. When this stage is reached, the trees will find little difficulty in sprouting, and in due time they will overtop the shrubs and resume their sway. This process is much accelerated in localities where stumps had remained after clearing, from which shoots could grow. A typical area of this kind, which has almost completed the cycle, is found on northwest quarter section 35, town of Milwaukee. Here there is a dense thicket formed by coppice growth of oak and basswood, the various shrubs mentioned above, with the witch hazel particularly numerous, and a great many large seedlings, among which, unfortunately, the hop hornbeam is excessively represented. Many of the stool shoots are 7 inches in diameter, while some of the seedlings are twelve feet high. In places the crowns begin to close, and there are traces of a lessened vitality among the witch hazel.

This course of regeneration is of course much retarded and often made impossible by the cropping of cattle. The effects of pasturing are conspicuous in a peculiar manner in the various species of hawthorn, a genus that is very common both within the forest and on neighboring pastures. The young plants, being constantly deprived of their leading shoots, spread laterally, with a great number of short spurs, until they form low clumps of semi-globular or pyramidal form, each short spur protected by formidable thorns. When these masses become large enough to prevent the cattle from reaching the buds in the centre of the mass, a leader begins to shoot upwards, and the plant at last succeeds in assuming its normal, tree-like form, with the globular or pyramidal mass of twigs surrounding the base of the trunk. Not rarely, a group of these grotesquely shaped hawthorns form a natural fence, behind which other shrubs and trees may grow in safety from the nibbling cows.

Taking it all in all the condition of woodlands in this vicinity is far from desperate. For one thing, fire, the curse of most American woods, is practically unknown here. While the value of the growing timber is at present small, it is not at all improbable that this will change after a while. The two species of timber most prosperous here are white oak and hard maple. Both of these are exceedingly valuable where the market conditions are in their favor. As to maple, Wisconsin lumber of this kind is now supposed to be inferior to the Michigan product, but the maple groves of lower Michigan are rapidly nearing exhaustion. Very likely the price of such lumber will rise considerably within the next twenty-five years. Then it may become profitable to set up a number of saw mills, of limited capacity, in Milwaukee, to utilize the hardwoods of this region. With proper management, the existing timber lots of this county would be capable of furnishing a permanent, annual supply of logs to such mills. The only condition would be that the individual owners of forest tracts would have intelligence enough to content themselves with an occasional, but substantial revenue by the sale of a limited number of trees at the proper time, instead of attempting to realize a small fortune at once by cutting and selling everything in sight. In anticipation of that time it will be wise for timber owners in this neighborhood to promote, by proper forestal management, the growth of the more valuable species, particularly maple and oak, on their lands, so that they may participate in the profits, when market conditions shall become favorable.

NATURAL HISTORY NOTES.

Notes on the Habits of the Mexican Horned Toad, *(Phrynosoma orbiculare,)* **in captivity.** BY P. H. DERNEHL—

Peculiar to the cold and dry regions of the Mexican plateau, where it inhabits sandy spots exposed to the sun, this lizard is frequently brought into our northern homes and markets. At various times I have received specimens, in an apparently healthy condition, sent to me from Mexico, through the mail, packed between layers of cotton in pasteboard boxes.

Those which I kept I provided with a large box on the front side of which I had arranged a wire netting admitting ample air and light. This cage I placed upon the veranda roof where the sun might strike it from all sides. They seemed to enjoy lying in the sun and basking for hours at a time and they were then quite active. On cold days or at night I found the creatures to be rather torpid and they then sought a small grotto, arranged within the cage, remaining within this seclusion until enticed to leave by the warmth of the day. They never attempted to bury in the sand which I had placed to a depth of eight inches upon the floor of their cage.

They permitted themselves to be handled without attempting to bite the hand that seized them or showing their disapproval in any other way.

Their food consisted mainly of flies. I used a wire fly trap to catch the flies, and when it was well filled with insects emptied the contents into the creatures' cage. The flies upon being thus liberated crawled to the wire front of the cage and crawled up and down it, and immediately upon noticing the flies within their domain the lizards would come close to the front and crouch down, in the manner of a cat, preparing for a spring, closely watching every move of the flies, and whenever an insect came within their immediate reach they would make a quick dart at it and though rather awkward in doing so, seldom missed their mark. Various beetles and other insects that were offered them at intervals were refused. I never noticed my specimens to drink from a small basin filled with water and kept in their cage, though I lay for hours at a time watching them through a small circular hole in the back of their cage.

In confinement this creature is at all times dull and stupid, and indifferent to its surroundings. It shows no sign of recognizing its keeper and in fact displays no qualities that might tend to make it in any manner attractive or to recompense those interested for the attention and care it demands.

With the best of care I have never succeeded in keeping my specimens alive for a longer term than six months and other persons likewise interested have reported the same results. Evidently the change of climate and diet is the cause of their short survival in captivity.

November Wild Flowers. BY W. J. BENNETTS. The following 36 species of plants were observed in flower in the vicinity of Milwaukee during the first 5 days of November of the present year, 1900. A period of winter weather had its beginning on Nov. 6 so that the season of wild flowers may be said to have closed on that date. It will be noted that the majority of the plants mentioned are common weeds and introduced species, although a few as the species of Gentiana, Aster, Hamamelis, are native plants with a late or extended flowering period.

Chrysanthemum Leucanthemum L. Oxe-eye Daisy. Abundant in a pasture south of the city.

Alsine media L. Chickweed. Common in a rich woods.

Rudbeckia hirta L. Yellow Daisy. One specimen found in a ravine.

Gentiana crinita Froel. Fringed Gentian.

Gentiana quinquefolia L. Five-flowered Gentian. Both species were found to be numerous in several ravines near County Line, 14 miles south of the city.

Sonchus asper (L.) All. Spiny sow-thistle. Not rare in several cultivated fields.

Sonchus oleraceus L. Found with S. asper.

Verbascum Thapsus L. Mullen. A few were still in flower in pastures and along lanes.

Carduus lanceolatus L. Bull thistle. A few flowering heads still remained on stout plants in several woody pastures.

Trifolium pratense L. Red Clover. Second crop in flower on many farms.

Trifolium hybridum L. Alsike. With the last.

Trifolium repens L. White Clover. In sheep pastures.

Melilotus alba Desv. Sweet Clover. Second growth plants in flower nearly everywhere.

Aster Lowrieanus Porter. A few found along roads and fences.
Aster laevis L. On the face of the lake bluffs.
Aster puniceus L. One specimen found in a woods.
Erigeron annuus Pers. Daisy Fleabane. Was very numerous in some fields.
Leptilon Canadense Britton. A few found in fields.
Gnaphalium obtusifolium L. Sweet Everlasting. One plant in a woody pasture.
Solidago Canadensis L. Canada Goldenrod. One specimen found in a woods.
Solidago flexicaulis L. Zigzag Goldenrod. One specimen found in a ravine.
Brassica arvensis L. Field Mustard. Abundant in many fields.
Brassica nigra L. Black Mustard. Was still common in the city.
Onagra biennis (L.) Scop. Evening Primrose. Not rare in fields along railroads, &c.
Prunella vulgaris L. Heal-all. Several found in a ravine.
Nepeta Cataria L. Catnip. By a fence in a pasture.
Bidens frondosa L. Beggar-ticks. Growing in water in a ravine.
Galinsoga parviflora Cav. Observed in a few waste places on the south side. Also on lawns on Grand ave.
Anthemis Cotula L. White-weed. A few found still lingering in waste places in the city.
Pastinaca sativa L. Wild Parsnip. Noted along railway tracks in the Menomonee valley.
Arctium minus Schk. Burdock. Found on weedy slopes of the Menomonee valley.
Saponaria officinalis L. Bouncing Bet. A few noticed near Calvary cemetery.
Bursa Bursa-pastoris (L.) Britton. Shepherd's Purse. On lawns in the city.
Taraxacum Taraxacum (L.) Karst. Dandelion. Scattered specimens were noted everywhere.
Hamamelis Virginiana L. Witchhazel. Common in thickets and woods.
Echinospermum Sp. Stickseed. One specimen near Juneau park.

The Last Anthophilous Insects of the Season. BY DR. S. GRAENICHER.—Sunday, Nov. 4th, of the present year was a remarkable day viewed from the standpoint of one interested in the study of the mutual relations of insects and flowers. The exceptionally warm weather prevailing at noon induced the writer to make a trip to the Menomonee Valley, west of the city limits, in order to catch a glimpse of what might be going on at the few flowers still in bloom in that neighborhood. What I saw surpassed my expectation; I had never thought of the possibility of witnessing such a gathering of flower-visiting insects so late in the season. The flowers on which the visitors were observed represented the following species: *Erigeron annuus, Pers., Taraxacum officinale, Weber, Sonchus oleraceus, L., Melilotus alba, Lam.* and *Pastinaca sativa, L.* Insects were numerous on the umbels of the latter, the wild parsnip, a few specimens of which were still in full blossom, growing along the railroad tracks. About 2 o'clock in the afternoon, the situation changed very abruptly; a cold wind set in from the northwest, driving the insects to shelter, and within a few minutes the flowers were deserted. This event marked the closing of the season.

Below I add a list of the 40 species observed on that day, November 4, 1900. This is an exceedingly late date of observation in our latitude:

Hymenoptera. Andrenidae: (1) Halictus disparilis, Cr. ♀; (2) H. laevissimus, Sm. ♂; (3) H. pattonii, Ashm. (M. S.) ♀; (4) H. inconspicuus, Sm. ♀; (5) Halictus sp. ♂;
Vespidae: (6) Polistes pallipes, Lep. ☿;
Braconidae: (7) Apanteles sp.;
Ichneumonidae: (8) Ichneumon sp.;

Diptera. Syrphidae: (9) Chrysogaster nitida, Wied.; (10) Syrphus americanus, Wied.; (11) Mesogramma marginata, Say.; (12) Eristalis, meigenii, Wied.; (13) E. tenax, L.; (14) Helophilus similis, Macq.; (15) Syritta pipiens, L.;
Conopidae: (16) Oncomyia loraria, Loew.;
Tachinidae: (17) Phorantha occidentis, Walk.; (18) Tachina mella, Walk.; (19) Trichophora ruficauda, v. d. W.;
Sarcophagidae: (20) Helicobia helicis, Town.; (21) Sarcophaga sp.;
Anthomyidae: (22) Phorbia fusciceps, Zett.; (23—24) Phorbia spp.;
Muscidae: (25) Stomoxys calcitrans, L.; (26) Pollenia rudis, F.; (27) Lucilia sericata, Mg.; (28) L. cornicina, F.; (29) Compsomyia macellaria, F.; (30) Morellia micans, Mg.;
Scatomyzidae: (31) Scatophaga squalida, Mg.;
Sepsidae: (32) Sepsis violacea, Mg.;

Agromyzidae: (33) Agromyza aeneiventris, Fall.;
Trypetidae: (34) Tephritis clathrata, Loew.;

Lepidoptera. Rhopalocera: (35) Pyrameis huntera, F.; (36)
Pieris rapae, L.; (37) Colias philodice, Gdt.;
Heterocera: (38) Plusia simplex, Gn.;

Hemiptera. Capsidae: (39) Lygus pratensis, L.; (40) Lygus sp.

Mounds Near Lisbon, Ransom Co., North Dakota. BY LEE R. WHITNEY. A solitary mound, occupying an elevated position on the west shore of a beautiful valley and about five miles northwest from Lisbon, was selected for exploration.

Its form was that of a frustrum of a cone, the diameter of whose base measured thirty feet, that of its superior plane, twenty feet, the height of the latter being about four feet.

I commenced digging a little to the west of the center, removing the earth stratum by stratum, observing and noting objects of interest as they appeared. After going to a depth of one foot, charred bones were found, and for a radius of six feet a little to the west of the center of the mound, nothing but charred bones were found, such as vertebrae, ribs, cranea, etc., also a skull of some small animal, charred. These had been apparently thrown in promiscuously, as if from disarticulated limbs. These bones were very easily broken and it was nearly impossible to secure a leg, arm or in fact any large bone intact that had been charred. Some of the bones of the leg, hand and back were found in a very good state of preservation, although considerably charred. Parts of the jaw bone were found with the teeth intact, all charred and burnt. About a foot to the east of the fire limit, in very nearly the center of the mound and about six inches deep, was found a shell ornament, consisting of a good size clam shell polished, with two deep notches and several smaller notches at the larger end. The deep notches being opposite one another, indicated that it probably had been used as a pendant. A polished bone needle three and one half inches long and a bone scraper made from a rib bone were also found near the shell.

To the west, one foot from the fire limit, was found a portion of a skull, a lower jaw bone, arm bones, etc., which had evidently escaped the fire. The jaw was found resting in the skull; the arm bones were placed promiscuously on top of the skull and jaw, and extended into the fire space. To the north of the fire limit, two feet away, was found a portion of the base of a skull which had been fractured before having been placed there, a piece having been broken out and two distinct cracks showing, as though caused by a heavy blow. Search was made for the remainder of the skull, but none was found.

After removing the charred bones, a layer two inches thick of charred wood, grass, twigs and leaves were found. This layer gradually thinned out at the outer edge of the fire. The center of this charred mass was matted together, probably by the glutinous subsance from the bones. Where this substance had not reached the twigs, etc., they were found to be loose and as soon as the trowel touched them, they broke and crumbled. Some very large logs were found. There were four logs or poles six inches through and at least six feet long, extending from nearly the center of the mound out in opposite directions, dividing the mound into four sections and apparently forming or shaping the mound, the central ends being elevated higher than the outer ends. The only piece that was procured intact was a portion of the central end of one log which extended through the fire and was partially burnt. This piece is very well preserved. The logs extending into the other portions of the mound not touched by fire had scarcely enough cohesiveness to enable them to retain their form. These logs were found in the same strata the bones were in and appear to be of a species of oak still growing in this vicinity in the ravines.

Prof. W. G. Crocker of Lisbon also excavated a small mound about two and one-half miles southeast of Lisbon on the east side of the river. In an interview he states that but one skeleton was found in this mound. It was in a sitting position in the center of the mound with arms extended, and in the hands was found a large shell, in the bowl of which were found the bones of some bird.

The Purple Martin. BY P. H. DERNEHL. The following record of the arrival and departure of this species may prove of interest:

In 1895 they returned to their boxes in my garden, April 2, left August 18
In 1896 " " " " April —, left August 16
In 1897 " " " " April 7, left August 15
In 1898 " " " " April 9, left August 13
In 1899 " " " " April 4, left August —
In 1900 " " " " April 15, left August 15

Their food while here consisted solely of insects—chiefly, wasps, bees, beetles and all manner of garden insects.

Mr. Jno. A. Brandon has mentioned an instance of the voraciousness of these birds. In a martin house which he had erected near his dwelling, in such a position that he could easily observe them while feeding their young, he noted among other insects brought by the parents, large dragon flies measuring fully three and one half inches in length. These the youngsters would greedily seize and gradually gorge head foremost until only the abdomen protruded. By degrees, this too disappeared and the little gluttons were then ready for another meal.

In a neighboring garden last summer a pair of martins took possession of a box, but after a time suddenly disappeared, the owner found upon investigating that the parents had left behind them a brood of four nearly naked nestlings. He took them into his house and fed them with insects which they readily took. Gradually as they grew older they demanded more attention; small insects in sufficiency to satisfy their cravings were difficult to procure, so as a last resort this gentleman engaged a couple of boys to catch grasshoppers for them and the number of these insects they devoured was astonishing—three large grasshoppers at a time being none too many. A short time of such procedure and the martins would come to him at his whistle and even after they were fully fledged and able to fly they would come from high where they soared with others of their kind, perch on his hand and take the offered morsel.

I have noted that the purple martin will invariably drive after and fight until he succeeds in driving from the vicinity of his place of abode, both the barn and the white-bellied swallows, whereas the sparrow, robin, wren, oriole and other birds different in habits, but holding to the same localities as the martin are left unmolested, so long as they do not assume the aggressive.

In the care of its own young the martin is very negligent. The young martins frequently tumble out of their nests and are invariably lost or become a prey to the cat. In times of draught many young martins perish and are at times entirely deserted by their parents, while from the four or six eggs which the martin lays, but three are hatched and reared successfully, on an average. When the time of migration arrives, their migratory instinct seems to conquer their maternal instinct and they frequently desert their tender young, leaving them to perish invariably in their nests. I have always found when lowering my martin boxes that the parents left behind them either eggs or more frequently one or two of their young.

Notes on Some Migratory Birds. BY J. A. BRANDON—THE SAPSUCKERS. *(Sphyropicus varius.)* These birds when on their northward journey generally arrive between April 8th and 12th, in vast numbers over night, and the next day the trees both in and out of the city literally swarm with them. They do not appear to do any material damage to the trees, yet one may see the punctures which they make in such a systematic way, in almost every tree. I observed one fellow in North Greenfield who had pierced the bark, I think of an elm, in three places one above the other; and I watched him for almost an hour, consecutively visiting these three wounds. When descending to the lower one he invariably went tail first. I repeatedly saw him excrete and before doing so he would reach up and catch hold of the bark with his bill and then let go his tail brace for the moment. They sojourn here in large numbers for a week or two, and during that time furnish rare sport for the mischievous boys with stones, slingshots and air rifles. The birds seem to be very stupid, and if a stone strikes close to one on a limb he generally remains still, thinking, perhaps, that a boy cannot hit the same place twice, and as a consequence they are frequently knocked off.

THE FOX SPARROW. *(Passerella iliaca.)* I have never seen a fox sparrow in the city, but during the two weeks they generally remain in the suburbs on their northward trip, they furnish abundant opportunity for interesting study. They have a very pleasing song, more so I think than any of the other sparrows except the vesper. When disturbed they do not seem to flit from one bush or limb to another, but generally make a good job of it and fly entirely away, not being so averse to crossing large spaces as most other small birds commonly are.

In scattered flocks of from ten to one hundred individuals, these busy fellows may often be found, and indeed heard, industriously scratching away among the dead leaves under the dense underbrush in the woods. He is a strong, hardy bird and scratches with both feet at the same time. They are generally so intent upon their hunting among the leaves that an observer can, when cautious, succeed in getting right amongst them without their taking the slightest notice of him, although they are usually shy birds and easily alarmed.

THE AMERICAN REDSTART, *(Setophaga ruticilla)* acts much in the same way as does the magnolia warbler only if possible it is more restless. Half flying, half jumping from one twig to another only to spring into the air a few feet away and viciously snap its beak on some passing insect which the observer is quite sure not to have seen; flitting, struting and jumping with quivering wings and tail spread, showing to advantage the beautiful band across it of salmon red, as well as the brilliant salmon red and black and white waist coat. This species is a common victim of the cow bird; their nests almost invariably containing one or more eggs of this parasite. In one instance I found a redstart nest containing four of the cow-bird eggs and the eggs of the owner were lying on the ground beneath, mostly broken. I have repeatedly found the eggs of this unbidden guest in the nests of the wood thrush, brown thrush, song sparrow, robin, chipping sparrow, field sparrow, red eyed vireo and yellow warbler, the last two almost sure to contain them. Eight or ten years ago I was fortunate enough to discover one of the two-storied nests of the yellow warbler which is so often written about but so seldom seen. The lower story contained an egg of the warbler with two of the cow bird, then another story built on top of this containing two of the cow bird and one of the owner. I have one in my possession only partly completed. The lower part was not finished before the parasite deposited an egg, the second part being started but left unfinished.

THE RUBY THROATED HUMMING BIRD. *(Trochilus colubris.)* Strange as it may seem this humming bird arrives as early as the last week in April. I have seen them as early as the twenty-fourth, visiting the flowers of *Salix discolor,* probably after minute insects and perhaps the pollen which is so abundant. It may be of interest to some to note that our common red squirrel is exceedingly fond of eating these blossoms.

THE CEDAR WAXWING. *(Ampelis cedrorum.)* This species in the spring has a decided liking for the buds of the soft maple. I have often seen them carefully insert their bills in the partially opened buds and apparently extracting something therefrom, probably the more tender inner parts. They also detach the buds and pick them to pieces and many will swallow the buds entire, the ground below some of the large trees being literally covered with mutilated buds. The trees do not seem to suffer in the least from this treatment, the foliage afterward coming in ordinary abundance.

These birds also seem to take to the berries of the mountain ash more ravenously at this time also. In a few hours they will entirely denude a tree of its berries, which have remained untouched all the previous winter.

THE MAGNOLIA WARBLER. (*Dendroeca maculosa.*) This warbler when feeding mostly confines himself to the upper and outer parts of a shrub, fluttering two or three feet into the air after some passing insect, returning, jumping here and there, then into the air again, always seemingly in a flurry of excitement.

THE BLACK AND WHITE WARBLER, *(Mniotilta varia.)*, on the contrary, methodically and deliberately pursues his way, almost in silence, up and down, over and around the limbs and stems, systematically scrutinizing every inch of surface, hanging, back head or tail downward, which ever way most suits his convenience, climbing downward head first, tail first or sidewise, with only his long slender claws to support and brace him, as his little bob tail invariably sticks straight out from his body and seldom or never comes in contact with the limb as does that of the woodpecker. He is perfectly fearless, as I have had them come within a few inches of my face, and in one instance hop onto my shoulder and off to a limb quite unconcerned. He confines his operations mostly to the inner and lower parts of the bushes, exploring them thoroughly from the ground out to the small twigs.

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Pellenes, and Some Other Genera of the Family Attidae.

GEORGE W. PECKHAM and ELIZABETH G. PECKHAM.

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Pellenes and Some Other Genera of the Family Attidae.

Pellenes E. S. 1876.

The cephalothorax is high, convex, and a little longer than wide, with the cephalic plate inclined, and the thoracic part dilated, and somewhat widened out from above downward. The quadrangle of the eyes is from one-fourth to one-third wider than long, occupies two-fifths of the cephalothorax, and is usually wider behind than in front, although in some cases it is equally wide in front and behind or wider in front. The front eyes form a straight or slightly curved row, the middle eyes being near together and about twice as large as the lateral, from which they are distinctly separated. The second row is about halfway between the first and the third; the third, is nearly as wide as the cephalothorax at that place, the eyes being almost equally distant from each other and from the lateral borders. The labium is at least as wide as long and is half as long as the maxillae. The falces are vertical, parallel and rather weak, with small fangs. Among the European species the legs are 1342 in the males and 3142 in the females, but among the American, the third and fourth are most commonly longer than the first and second in both sexes. The male palpus is very constant in form, the bulb being short and rounded.

The males of *Pellenes* have, usually, some peculiar modification of form, color, or ornament, appearing in the first and third legs. These fringes, enlargements, and markings are used to attract and delight the female during courtship, the posturing and dancing being such as to show off every beauty to the greatest advantage.* They make the identification of the males comparatively easy, while the females resemble each other so closely as to make it very difficult to distinguish them. The young males are like the females until within one or two moults from maturity.

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*An account of the courtship of *P. splendens* and *P. Howardii* mav be found in our paper, *Sexual Selection in Spiders of the Family Attidae*, Occ. Pap. Nat. Hist. Soc. of Wisconsin, Vol. 1, No. 1, 1899, and Vol. 1, No. 3, 1900.

All the species which we have formerly described under *Habrocestum* we now place in *Pellenes,* M. Simon, who is the author of both genera, having assured us that this is their proper place, while *pulex* Hentz, which we had supposed to belong to *Saitis,* is classed by him under *Habrocestum.* The species resemble each other closely in their form, and often in their patterns.

To make this paper as complete as possible we include in the key such of Mr. Banks' species as he has been able to lend to us. Mr. Banks thinks the spider which we describe as *P. auratus* H. is a new species, but in this we disagree with him. He also says (Jour. N. Y. Ent. Soc. p. 92, June, 1895) that his species *Habrocestum latens,* 1892 (together with *Ergane taeniata* Keys, and *Hasarius Hoyi* P.), is a synonym of *Ergane borealis Blkw. H. latens* Bks. must not be confused with our *Habrocestum latens* 1896, which we now place under *Pellenes.*

The first species described by M. Simon under the genus *Pellenes* is *lapponicus,* which may therefore be regarded as the type.

So far as we have seen the species described by Koch and Keyserling, in *Arachniden Australiens,* under the name *Habrocestum,* we think them nearer to *Saitis* E. S. than to *Pellenes* or *Habrocestum.*

We hope that the key. made from the American species of *Pellenes* in our collection, will lessen the difficulty of identification. Besides the species described in this paper the key includes *borealis* and *signatus* Banks, both described in *The Canadian Entomologist,* the former in 1895 and the latter in 1900, *conjunctus, divaricatus and aztecanus* Banks, *Arachn. from Baja California and other parts of Mexico,* Proc. Acad. of Sci. of California, 3rd Series, Vol. I, No. 7, pp. 285-287, *montanus* Emerton, *Canadian Spiders,* Trans. Conn. Acad., IX, July 1894, p. 420, *coecatus* H., *auratus* H., *viripedes* H., *cristatus* H., *hirsutus* P., *peregrinus* P., *oregonensis* P., *splendens* P., described in our *Attidae of North America,* Wisconsin Acad. Sci. Arts and Letters, Vol. VII, *latens, mexicanus, belligerus* and *paratus* P., *Attidae of Central America and Mexico,* Occ. Pap. Nat. Hist. Soc. of Wisconsin, Vol. III, No. 1, April 1896. We have omitted *coronatus* H. because our specimen is immature. All of these species were described under the generic name *Habrocestum.*

Key to Males of Pellenes.

1	Some of the legs fringed, or enlarged, or both...	2
	Legs not fringed nor enlarged..................	14
2	Legs 3142, 3142 or 3142........................	3
	Legs 3412*.....................................	6

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*In some individuals of *hirsutus* the relative length of the legs is $3\overline{14}2$, but the iridescence on the first leg serves to distinguish the species.

3	Third leg not modified	4
	Third leg modified	5
4	Red hairs on clypeus	*signatus*
	No red hairs on clypeus	*auratus*
5	Longitudinal white band on middle of abdomen	*Howardii*
	Transverse white band on middle of abdomen	*brunneus*
6	Only the first leg modified	7
	Third leg, or both first and third legs modified	9
7	First leg much enlarged, tibia as wide as long, with fringe of stiff dark hairs; spider nearly covered with iridescent red	*oregonensis*
	First leg dark, with metatarsus flattened and iridescent; clypeus red	*hirsutus*
	First leg yellow or brown, with metatarsus not flattened nor iridescent; clypeus not red	8
8	**Legs brown. Fringe of white hairs on upper sides of femur patella and tibia of the first, and of smoky hairs** on lower sides of the same joints. Clypeus white with a touch of fawn-color below the middle eyes	*Birgei*
	First leg with fringes above and below, on femur, patella and tibia, the hairs being white on all three joints above and on the femur and patella below, while on the underside of the tibia they are dark; no black lines on metatarsus and tarsus of first	*conjunctus*
	Clypeus and front faces of falces covered with fawn-colored hairs, legs yellow. First leg with a fringe on upper side of femur, patella and tibia and on the under side of the tibia, the hairs on the femur being white, on the upper side of the patella and tibia white with a bunch of dark ones in the middle of each joint, and on the underside of the tibia, dark; no black lines on metatarsus and tarsus of first	*elegans*
	First leg with only a dark fringe on the under side of patella and tibia; metatarsus and tarsus of first with black lines	*tranquillus*
9	Clypeus red; no iridescence on metatarsus of first leg	*coecatus*
	Clypeus not red; or clypeus red, and metatarsus of first leg iridescent	10
10	Abdomen having longitudinal median, and encircling white bands, with velvety black on sides; no transverse nor oblique bands	11
	Abdomen with transverse or oblique white bands.	12
11	Clypeus covered with long, thick white hairs; habitat, eastern United States	*peregrinus*
	Clypeus dark, with a long white spot under each lateral eye; habitat, Mexico	*divaricatus**
12	Abdomen with broken figures down middle line and two oblique bands on each side	*mexicanus*
	Abdomen with white basal band and second transverse band further back, the two connected by a median white band	13

**Divaricatus* is distinguished from all other species by having, along with the peculiar modification of the patella of the third leg, a serrated edge on the apophysis of the tibia of the palpus, and an unusual coloration of the clypeus. The palpus is well shown in Mr. Banks' illustration of this species.

13	Length 6 mm; tibia of first leg with two longitudinal black lines; femur and patella of third each with an apophysis; falces brown.........	*festus*
	Length 5 mm; femur, patella and tibia of first leg with one longitudinal black band; no apophysis on femur of third, which has distal half light colored, with transverse black lines; patella of third yellow, with a strong apophysis which is blackish on the end, with a long, stout spine; falces covered with white hairs on the inner two-thirds, with the outer third black....................	*aztecanus*
	Length 4.5 mm; tibia of first without black lines; femur of third without apophysis; patella of third with two apophyses; falces covered with white hairs......	*Klauserii*
14	Legs 1342; clypeus red..........................	*paratus*
	Third leg longest; clypeus not red..............	15
15	Cephalothorax and abdomen highly iridescent, cephalothorax dark, abdomen bright red.......	*splendens*
	Different coloration............................	16
16	Tibia of palpus with a large apophysis, straight on lower edge, rounded above, wider at end than at base; legs 3142...........................	*montanus*
	Tibia of palpus without any such apophysis......	17
17	Abdomen with median and encircling bands white, and two yellow bands on sides; no transverse band	*limatus*
	Abdomen with different coloration...............	18
18	Cephalic part with two white streaks starting between the large middle eyes and diverging a little as they pass backward, and two white bands running from the lateral eyes back on to thoracic part; no crest of black hairs............	*viridipes*
	Cephalic part without white bands but having a crest of long black hairs over first row of eyes..	*borealis*

Key to Females of Pellenes.

1	Third leg longer than fourth by less than tarsus..	2
	Third leg longer than fourth by at least tarsus..	3
2	Habitat, New Hampshire.......................	*borealis*
	Habitat, California............................	*signatus*
3	Third leg longer than fourth by a little more than tarsus	4
	Third leg longer than fourth by tarsus and metatarsus	14
4	First leg longer than second by less than tarsus and metatarsus.............................	5
	First leg longer than second by tarsus and metatarsus	13
5	First leg longer than second by tarsus and nearly the matatarsus; a white streak running back from between middle anterior eyes; a herringbone stripe on the abdomen; habitat, Texas..	*Townsendii*
	First leg longer than second by only tarsus......	6
6	A distinct light basal band on abdomen........	7
	No distinct light basal band on abdomen........	12

7	Clypeus chestnut-colored and white	8
	Clypeus not chestnut-colored and white	9
8	Clypeus with a white margin	*carolinensis*
	Clypeus without a white margin	*sabulosus*
9	Abdomen having longitudinal central and side bands white, with dark bands between	10
	Abdomen without such bands	11
10	Cephalothorax with scalloped yellow band marking off eye-region; habitat, United States	*peregrinus*
	Cephalothorax without such band; habitat, Mexico	*simplex*
11	Cephalothorax with a white streak running back from clypeus, between middle eyes, on to cephalic plate, where there is a diamond shaped white spot	*hirsutus*
	Abdomen with a scalloped yellow band, distinctly outlined in black	*viridipes*
	No white streak nor yellow band	*latens*
12	Body all covered with gray hairs; a white band on posterior part of abdomen with oblique chestnut-colored bars on the edges; habitat, Utah	*griseus*
	Abdomen dark with herring-bone stripe and oblique bands white; habitat, Canada	*montanus*
	First leg longer than second by less than tarsus; abdomen sometimes having an indistinct light basal band, and marked by two oblique light bands, which in some specimens are continuous over the anterior dorsum, a light spot, outlined in black, and two light spots above the spinnerets; habitat, east and south United States	*cristatus*
	Body fawn-colored; sides and thoracic part of cephalothorax whitish; abdomen with two oblique black bands on each side; habitat, Wisconsin	*Howardii*
	Body fawn-colored; lower sides of abdomen with indistinct white bands, upper sides with two black scallops; posterior part with light chevrons outlined in black; habitat, Guatemala	*belligerus*
	Body yellowish-gray, having, under alcohol, an indistinct light herring-bone stripe on the abdomen; when dry, without markings; habitat, Utah	*candidus*
13	Abdomen black and white, the latter having sometimes a tinge of salmon	*splendens*
	Abdomen brown	*nemoralis*
14	First leg longer than second by less than tarsus and metatarsus	15
	First leg longer than second by tarsus and metatarsus	17
15	First leg longer than second by tarsus and part of metatarsus; cephalothorax covered with a mixture of red and white hairs; a ridge of black hairs over anterior eyes	*superciliosus*
	First leg longer than second by only the tarsus	16
16	Clypeus with chestnut-colored spots; habitat, New Mexico	*politus*

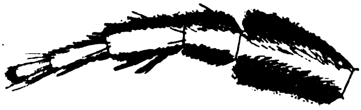
16	Three longitudinal white bands throughout the length of the cephalothorax; habitat, Mexico	*mexicanus*
	Cephalothorax fawn-color with a black margin; a light, median, longitudinal band on abdomen, on each side of which the color is dark; habitat, Mexico	*placidus*
	Body gray, with white spots down middle of abdomen, and white oblique bands on sides; habitat, New York, South Carolina, Georgia	*auratus*
17	Cephalothorax with three white, longitudinal streaks, those on sides including lateral and dorsal eyes, the middle one sometimes indistinct	*cognatus*
	No such streaks	*dolosus*

Abbreviated Descriptions of the American Species of Pellenes. Males.

P. Howardii.

The abdomen has a white band down the middle with a black band on either side, and is encircled by white. The first leg is fringed with white hairs. In the third leg the patella has the distal end enlarged. Legs 3$\overline{14}$2. From Wisconsin.

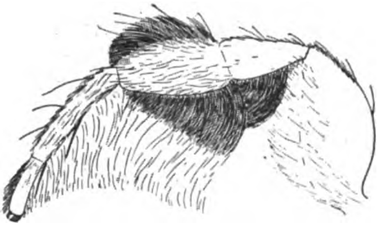
P. brunneus.



First Leg of Male.

The abdomen has a white basal band and a second transverse white band further back, the two being connected by a white band which extends from one to the other. Further back is a short median longitudinal white band. The first leg is heavily fringed with white and brown hairs, and the third, has one apophysis on the femur and two on the patella. Legs 3142. From Florida.

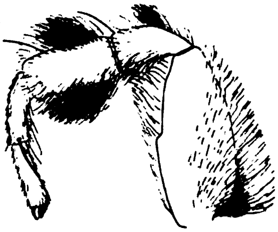
P. hirsutus.



First Leg of Male.

The clypeus is red. The first leg is heavily fringed and has the metatarsus flattened, and bluish-iridescent in color, with two long dark spines. The third leg is unmodified. From Oregon, Utah and New Mexico.

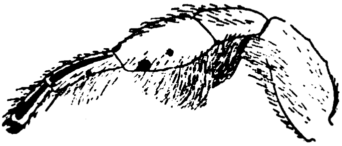
P. elegans.



First Leg of Male.

The abdomen is brown with median longitudinal, and encircling white bands. The first leg is fringed, with alternating bunches of white and brown hairs. Legs 3412. The cephalothorax, including clypeus and falces, is covered with fawn-colored hairs. From California.

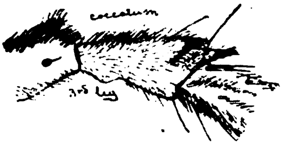
P. tranquillus.



First Leg of Male.

First leg with tibia enlarged and fringed with long white hairs underneath. The patella and tibia have, also, a fringe of dark hairs. The metatarsus and tarsus have black lines. Legs 3412. From Arizona.

P. coecatus.



Third Leg of Male.

The clypeus is red. First leg with brushes of hairs on the femur. Third leg with apophysis on the patella. Legs 3412. From Eastern and Southern United States.

P. festus.

Legs 3412. The abdomen is black, with a basal band and a second transverse band further back, white, the two being connected by a white band which runs from one to the other. The first leg is fringed with white hairs, and has, on the tibia, two longitudinal black lines. In the third leg the femur and patella have each an apophysis. From Utah.

P. Klauserii.

The abdomen is black, with a basal band and a second transverse band further back, white, the two being connected by a white band which runs from one to the other. The first leg has a short fringe of white hairs. The third leg has an enlargement at the distal end of the femur and two apophyses on the patella. The falces are covered with white hairs. From New Mexico.

P. limatus.

The abdomen has white bands encircling the dorsum, and down the middle, and a band of yellow hairs down each side. The legs are not fringed nor enlarged, the relative length being 3412. The third leg is longer than the fourth by part of the tarsus. The clypeus is yellow. From California.

P. Birgei.

The abdomen has median longitudinal and encircling bands white, with brown on each side of the dorsum. Legs 3412, the third exceeding the fourth by the tarsus and half of the metatarsus. The clypeus is white. From New Mexico.

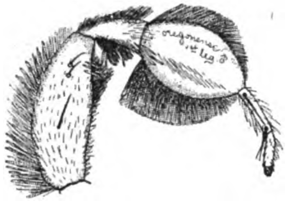
P. signatus.

Legs 3142, covered with short white hairs. The first leg has a bunch of short black hairs under the femur and a dark fringe under the tibia and patella. The third leg is unmodified. The clypeus is red. From California.

P. auratus.

The abdomen has median longitudinal and encircling white bands, with black bands down the sides. There are bunches of dark hairs on the femur, patella and tibia of the first leg. The relative length of the legs is 3142. The third leg is unmodified. From Eastern and Southern United States.

P. oregonensis.

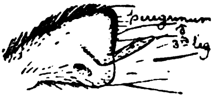


The cephalothorax (including clypeus) and abdomen are nearly covered with iridescent red hairs. The first leg is much enlarged, the tibia being as wide as long with a fringe of stiff dark hairs. From Oregon.

P. conjunctus.

The cephalothorax is reddish, this color being brightest on the cephalic plate, between the eyes of the first row, and along the upper sides of the cephalic part. Across the clypeus and around the margin is a white band. The relative length of the legs is 3412. The first leg has a white fringe along the upper side of the femur, patella and tibia, and along the under side of the femur and patella, the tibia having dark hairs below. The abdomen is brownish with median longitudinal and encircling white bands. From Lower California.

P. peregrinus.



The abdomen has a white band down the middle, a velvety black band on either side, and is encircled by white. The clypeus is covered with white hairs. The patella of the third leg is enlarged. The relative length of the legs is 3412. From Eastern United States.

P. divaricatus.

The clypeus is brown with a pure white elongated spot below each lateral eye running vertically to the margin. The tibia of the palpus has a serrated apophysis. From Lower California.

P. mexicanus.

The abdomen is brownish with broken figures down the middle line, and two oblique bands, white. The relative length of the legs is 3412. The first leg has fringes of brown hairs on each side of the femur and patella. At the distal end of the femur of the third is a rounded enlargement with a black spot in the middle. From the northeastern part of Mexico.

P. aztecanus.

The abdomen has a basal band and a second transverse band, white, the two being connected by a short white band. The falces are covered with white hairs on the inner two-thirds, while the outer third is black. The relative length of the legs is 3412. The femur of the third leg has the distal half light colored with transverse black lines, and the patella of this leg is yellow, with a strong apophysis, which is blackish at the end with a long stout spine. The clypeus is white. From Mexico.

P. paratus.

The clypeus is red. The abdomen is covered with yellow hairs, excepting three large white spots on the back, and four obliquely elongated white spots on each side. The relative length of the legs is 1342, the first being much the longest. Tibia of palpus with an apophysis which is blunt, and nearly as wide as long. From the eastern part of Guatemala.

P. splendens.

The cephalothorax and abdomen are highly iridescent, the cephalothorax being dark and the abdomen bright red. The legs are not modified. From Wisconsin, Massachusetts and Florida.

P. montanus.

The abdomen has a light herring-bone stripe down the middle, and a row of oblique light and dark markings on each side. Legs 3142, unmodified. Tibia of palpus with a large apophysis, straight on lower edge, rounded above, and wider at end than at base. From Rocky Mountains, Canada.

P. viridipes.

Legs 3412, unmodified. The cephalothorax has four white lines from the first row of eyes, extending over the cephalic plate. The abdomen is black, with a basal band, a scalloped band which encircles the posterior two-thirds of the dorsum, and a central spot, of a yellowish-white color. From Southern United States.

P. borealis.

The abdomen is black with a white basal band and a second white transverse band further back. The legs are unmodified, their relative length being 3412. From New Hampshire.

P. clypeatus.

The abdomen is black with a basal band and a median stripe white. The clypeus is black with a few white hairs in the center, and a conspicuous, elongated, vertical spot under each side eye. The first leg is black except the metatarsus and tarsus, which are pure white; the leg is clothed with white scales, those under the tibia being extremely long and pedicellate. The third leg is not modified. From Colorado. Not in our collection.

P. dorsalis.

The abdomen is brown, paler beneath, with white scales and long hairs. There is a narrow white median stripe from base to apex, its posterior part broken into spots. There are some small spots on the sides. The clypeus is dark. The third leg is unmodified. From Hermosillo, Mexico. Not in our collection.

Females.

P. nemoralis.

General color, brown. The cephalic plate is covered with white and copper-colored hairs. There is no ridge of hairs above the first row of eyes (as in *superciliosus*). The third leg is longer than the fourth by a little more than the tarsus. From Arizona.

P. superciliosus.

The abdomen is reddish brown, with pale chevrons down the middle. There is a ridge of black hairs above the first row of eyes. The third leg is longer than the fourth by the tarsus and metatarsus. From Arizona.

P. politus.

The cephalic part has three longitudinal white bands. There is a white basal band on the abdomen. The hairs around the front middle eyes are rufus, above and below, and white on the sides. The middle of the clypeus has a large snow-white triangle, and outside of this are alternating bands of white and chestnut. The third leg longer than the fourth by the tarsus and metatarsus. From New Mexico.

P. hirsutus.

There is a distinct light basal band on abdomen. The white between the two middle eyes of the first row is continued back, soon dividing into two bands, which unite with the bands that come up from the thoracic slope, thus a diamond shaped white spot is formed on the cephalic plate. There are also white lines extending from the anterior lateral eyes to the dorsal eyes on each side. From Oregon, Utah and New Mexico.

P. simplex.

The abdomen has longitudinal central and side bands light-colored with dark bands between. On the sides of the cephalothorax the hairs are white; the lower margin has a black line between two white lines. From Vera Cruz, Mexico.

P. griseus.

The abdomen is grey, with a central white band on the posterior part, on the sides of which are oblique chestnut-colored bars. The cephalothorax has on its margin a black line between two white lines. From Utah.

P. candidus.

There is no light basal band on the abdomen, which is entirely covered with yellowish-grey hairs. There are white hairs on the sides and posterior thoracic slope of the cephalothorax. From Utah.

P. carolinensis.

The abdomen is velvety black, with markings of a bright pinkish and salmon-color. Clypeus white, with a chestnut-colored band running outward from each of the middle eyes, not reaching the margin. The third leg is longer than the fourth by little more than the tarsus. From South Carolina.

P. sabulosus.

The abdomen is black, mottled with gray, with a lighter basal band running on to the sides. Clypeus white, with a chestnut-colored spot passing outward from each of the middle eyes down to the margin. The third leg is longer than the fourth by little more than the tarsus. From Georgia.

P. placidus.

The abdomen is dark brown, with a median longitudinal light band which reaches neither base nor apex. The third leg is longer than the fourth by the tarsus and metatarsus. The first leg is longer than the second by only the tarsus. From Mexico.

P. cognatus.

There are three longitudinal white bands on the cephalic part. The abdomen is fawn-colored with a light encircling band, and a band of light chevrons, reaching neither extremity, on the abdomen. The clypeus is white. The third leg is longer than the fourth by the tarsus and metatarsus, and the first leg exceeds the second by the same joints. From Kansas and New Mexico.

P. dolosus.

The third leg is longer than the fourth, and the first is longer than the second, by the tarsus and metatarsus. There are no white bands on the cephalothorax. The clypeus is covered with white hairs. The falces are brown. From Arizona.

P. Townsendii.

The first leg is longer than the second by tarsus and nearly all of the metatarsus. There is a white streak running back from between the middle anterior eyes. There is a white herring-bone stripe on the abdomen. From Texas.

P. peregrinus.

The first leg is longer than the second by only the tarsus. The abdomen has a distinct white basal band and three white stripes, with black between. The clypeus is white. From New York, Connecticut.

P. viridipes.

The third leg is longer than the fourth by a little more than the tarsus, and the first is longer than the second by only the tarsus. The abdomen is blackish, with a basal band, a scalloped band which encircles the posterior two-thirds, and a central spot, of a yellowish white color. From Southern United States.

P. latens.

The first leg is longer than the second by only the tarsus. There is a light band on the base and sides of the abdomen, and on the posterior third of the dorsum are some alternating light and dark chevrons. From British Honduras.

P. montanus.

The first leg is longer than the second by only the tarsus. There is no distinct light basal band on the abdomen, which is dark, with white herring-bone stripe and oblique bands. From Canada.

P. cristatus.

The first leg is longer than the second by less than the tarsus. The abdomen is covered with grayish-rufus hairs, and has slender lighter bands edged with black, which curve up over the sides toward the middle. Behind is a lighter spot edged with black, and two light spots above the spinnerets. From Eastern and Southern United States.

P. Howardii.

The first leg is longer than the second by only the tarsus. The body is fawn-colored, except the sides and thoracic part of the cephalothorax, which are whitish, and two oblique black bands on each side of the abdomen. From Wisconsin.

P. belligerus.

The first leg is longer than the second by only the tarsus. The abdomen is fawn-colored with indistinct light bands on the lower sides, and with two black scallops on the upper sides. The posterior part has light chevrons, outlined in black. From Guatemala.

P. splendens.

The first leg is longer than the second by the tarsus and metatarsus. The abdomen is velvety black, with basal, central and lateral white bands, which are sometimes tinged with salmon. From Wisconsin, Massachusetts and Florida.

P. mexicanus.

The third leg is longer than the fourth by the tarsus and metatarsus, while the first is longer than the second by only the tarsus. There are three longitudinal white bands throughout the length of the cephalothorax. The clypeus is covered with long white hairs. From Reynosa, Mexico.

P. auratus.

The first leg is longer than the second by only the tarsus. The abdomen is gray with white spots down the middle, and oblique white bands on the sides. From New York, South Carolina and Georgia.

P. signatus and *P. borealis* Banks.

These two species are distinct from all others by having the third leg longer than the fourth by less than the tarsus. They are very like each other, and as our specimen of *borealis* is one moult from maturity they cannot be distinguished by the epigynes. *Borealis*, however, is from New Hampshire, while *signatus* is found in California.

P. cinctipes Banks.

The abdomen is light gray, with a large, long brown stripe above with projections on its sides, and containing some pale chevrons behind; the sides and venter are light gray. The anterior pair of legs is dark, pale at bases of patellae, tibiae and metatarsi; the other pairs are pale, all joints being dark at bases and tips. The clypeus is dark with long white hairs on the margin. From Cape Region of Lower California. Not in our collection.

P. dubitatus Banks.

The abdomen is pale on the sides and below. Above it is mostly brownish, with a median white stripe behind and two white side spots. The clypeus is white with long white hairs. From Cape Region of Lower California. Not in our collection.

Pellenes Howardii, n.

Pl. I, figs. 1-1b.

♂. Length, 4.3 mm.; ♀, 5.5 mm. Legs, 3$\overline{14}$2, the first very little stouter than the others. In the male the legs of the first pair are fringed, and those of the third pair have an enlargement on the patella.

The quadrangle of the eyes is one-third wider than long and is wider behind than in front. The first row of eyes is straight, the middle eyes subtouching, and less than twice as large as the lateral, which are separated from them. The clypeus is nearly as wide as the middle eyes.

In the male the cephalic plate is covered with hairs of a soft fawn-color tinged with reddish, and is limited, behind, by a ridge and a scalloped yellowish-white band. The sides of the cephalothorax and the middle of the thoracic slope, are velvety black. A wide white band runs back from each dorsal eye to the posterior margin, and then curves forward and passes along the lower side as far as the dorsal eye. Around the lower margin is a black line with a narrow white line above it. The abdomen has velvety black bands on the sides of the dorsum, on each of which, near the posterior end, is a white dot. There is a wide encircling white band, which sends up an oblique band in the anterior part, and down the center is a wide white band which is enlarged in the middle to form an arrow-shaped mark. The first legs, in life, are of a tender green color, the others yellowish with white scales. The first has, on the outer under side of the femur, a thick fringe of white, continued in a thin fringe which is short on the patella and long on the tibia. The tibia has also some long white hairs, and two black spines on the inner side. The third leg has the patella enlarged at the distal end, and has a short curved apophysis which extends over the tibia. The front face of the enlarged part is pale and on it is a small black spine. This is evidently in the nature of an ornament since it is used in display during courtship. The clypeus and the front of the falces are covered with thick snow-white hairs. The palpi are brown with white hairs.

In the female the body is nearly covered with a mixture of white and fawn-colored hairs with longer black hairs over them. The fawn-color predominates everywhere excepting on the sides and thoracic part of the cephalothorax, which are nearly white. There are two oblique black bands on each side of the abdomen. The clypeus is thickly covered with brownish white hairs. The falces have only a few white hairs. We have numerous examples from Wisconsin.

Pellenes brunneus, n.

Pl. I, fig. 2.

♂. Length, 5 mm. Legs, 3142.

Quadrangle of eyes a trace wider behind than in front, and one-third wider than long. First row straight, all slightly separated. Middle eyes nearly twice lateral. Second row halfway between the others. Clypeus nearly equal to diameter of middle eyes. Labium as long as wide, and about half the length of maxillae. The sterum is light brown, with a circle of white hairs surrounding the central part. The first leg is adorned with fringes, the femur, patella, and tibia having two rows of dark hairs, with many white hairs extending beyond their tips, and also disposed over other parts of the leg; on the tarsi and metarsi the hairs are too thin to form fringes. Two large, dark spatulate spines come off from the anterior side of each tibia.

The cephalothorax is dark brown. Covering the clypeus, and extending back on either side is a narrow band of white. This white turns up on the thorax but does not reach the top. Behind each dorsal eyes is a short white spot. The cephalic plate is covered with short yellowish hairs, surrounded by a whitish border, which lies just within the quadrangle of the eyes. The abdomen is black, with a white basal band, which runs down on to the sides. Near the middle is a second transverse white band, the two being joined by a white band which extends from one to the other in the middle of the dorsum. Further back there is another short median longitudinal band, also white, with white spots on either side just above the spinnerets. The posterior sides are scalloped, the points of the scallop coming up a little toward the top of the abdomen. The under side has four light bands uniting at the spinnerets; between the bands the color is dark.

The last three pairs of legs are yellow, with many short white hairs and some black marks. The third leg has the femur constricted and rounded at the distal end with a short apophysis above, and a black dot in front. Several black longitudinal lines appear on the anterior and upper sides. The patella has two short apophyses on the upper part. The joints of the palpus are covered with short white hairs. We have one male from Florida.

Pellenes hirsutus Peckham.

Hab. hirsutum 1888. ♂. *North American Attidae,* Wis. Acad. of Sciences, Arts and Letters, Vol. VII, p. 64.

Length, ♂ 5 mm.; ♀ 6 mm. Legs, 3412 or $3\overline{14}2$. Third leg in the male longer than fourth by tarsus and part of metatarsus.

Quadrangle of eyes plainly wider behind, and one-third wider than long. First row straight, all eyes subtouching, middle eyes nearly twice lateral, second row halfway. Clypeus one-half as high as middle eyes of first row. Labium about as wide as long and less than half maxillae. The sternum is light yellow in the center, surrounded by a dark brown band. The first leg of the male is modified and enlarged; the femur has a fringe of white hairs on the under side, and a second white line parallel with it, which, on the dark color of the femur, is very striking. On the upper side are several long, moderately stout spines. On the under side of the patella and tibia are fringes of long hairs. One, the shorter, is a smoky brown, the other, much longer, is white; the two layers of hairs being in apposition. There are no fringes on the upper part of the patella, but the one on the tibia is short, thick and dark, the tibial joint, while enlarged, is still about twice as long as wide. The metatarsus is flattened in front, and is iridescent bluish in color. There are two long, dark-colored spines, and a fringe of white hairs, on the under side; the latter extends to the tarsus. The other legs are unmodified in both sexes.

In the male the cephalothorax is yellowish-brown. White bands on the lower margin run back on either side, from a point below the location of the small eyes; before reaching the end they turn up over the back, and slightly approach each other. At the dorsal eyes they become indistinct, in some specimens being continued as far forward as the first row of eyes, while in others they blend with the yellowish color of the cephalic plate. The anterior sides and the clypeus* are rather yellow than brown, while the back, between the white bands, is quite dark. The femora of the posterior three legs are yellow, the other joints are darker, and all are covered with short white hairs. The abdomen is dark-brown, with many lighter colored hairs. Two white bands come off from the base of the abdomen and run obliquely down the sides; and just above the spinnerets are three or four very short white chevrons. Underneath, the color is light yellow.

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*In some specimens the clypeus is red.

In the female the cephalothorax is yellowish-brown, mottled with many white hairs; the lower margin is white, except at the middle of the posterior slope; the two lateral bands pass up over the back, at first very slightly approaching each other, just at the dorsal eyes, and thereafter diverging. The clypeus is white, and the white is continued up and between the two anterior middle eyes, when it divides into two bands, which unite with the two that come up from behind; thus a diamond-shaped white spot is formed on the cephalic plate. White lines extend from the anterior lateral eyes to the dorsal eyes on each side. These patterns are more or less distinct, depending upon the amount of white mixed with the brownish ground color. The abdomen, while brownish in color, is much more mixed with white hairs than in the male; there is a more distinctly white basal band, which passes down the sides. There are two oblique white bands on each side just behind the middle. In the middle of the posterior half of the back is a darker band, marked with two or three white chevrons or spots. The legs are light yellowish-brown, more or less covered with short white hairs.

We have this species from Oregon, Utah and New Mexico. (Prof. T. D. A. Cockerell.)

We have four males of *Pellenes* with the clypeus red, *signatus,* California, *hirsutus,* Oregon, Utah and New Mexico; *coecatus,* Southern and Eastern United States, and *paratus,* Guatemala. *Hirsutus* is distinguished from the others by the flattened iridescent metatarsus of the first leg; *coecatus,* by the modification of the third leg; *paratus,* by having the first leg plainly longest and stoutest, with no modification of either the first or third; it has, also, the apophysis on the tibia of the palpus as wide as long. *Signatus* has no modification of the third leg, no iridescence on the metatarsus of the first, and has the relative length 3142. *Coronatus* Hentz has a red clypeus, but we have never seen a mature specimen, and are inclined to think that it may be the last moult before maturity of *coecatus.*

Pellenes elegans, n.

Pl. I, fig. 3.

♂. Length, 5 mm. Legs, 3412.

Quadrangle of eyes wider in front, and nearly one-third wider than long. First row of eyes straight, and but little separated, the middle being nearly twice as large as the lateral. Second row nearer first than third. Clypeus about half as high as diameter of large eyes. Labium wider than long, and hardly one-third the length of the maxillae. The sternum is light brown. The first leg is ornamented; on both sides of the femur and on the under side of the patella are fringes of white hairs; on the upper side of the patella the fringe is dark in the middle and white at the ends; the tibia has dark hairs underneath, while above, the hairs are white, then dark, and thereafter white; the metatarsus and tarsus are without fringes. The arrangement of the white and dark hairs on the first leg is very striking, and serves to distinguish it from all the males thus far described.

The whole cephalothorax is covered with short fawn-colored hairs, including the clypeus and front of falces; on the lower margin of the sides are two white lines, separated by yellow hairs. At the posterior end of the head the lines unite and are continued back as a white band. These bands do not appear to have run up the back of the thorax, as is so common in other species of this genus, but as our specimen is rubbed we cannot be certain on that point.

The abdomen is brown with a tinge of gold. The sides are white, and in the middle is a white band extending from base almost to the end; this band is slightly attenuated behind. The legs are yellow with darker bands.

We have one male from California.

Pellenes tranquillus, n.

Pl. I, fig. 4.

♂. Length, 5 mm. Third leg, 4 mm. Legs, 3412. First leg longer than second by tarsus and one-half metatarsus. Third leg longer than fourth by tarsus.

Quadrangle of eyes wider behind than in front. First row straight, with the middle eyes subtouching, and the lateral a little separated from them; middle twice as large as lateral eyes. Eyes of third row as large as lateral eyes of first row, placed a little further from each other than from lateral borders. Clypeus two-thirds as high as middle eyes of first row. Maxillae truncated in front and straight on inner edges. Labium as wide as long. Sternum oval. On the upper side of the femur of the first leg are three small points. This leg has the tibia enlarged, and ornamented with a long fringe of white hairs underneath, and some yellowish-white rice-like scales. Metatarsus and tarsus of this leg marked with a line of black. Second leg with a short fringe under the patella and tibia.

Our specimen is very much rubbed. The clypeus seems to have been covered with fawn-colored hairs. On the sides of the cephalothorax are many white hairs, which are also found above the first row of eyes, and at the anterior end of the abdomen. The species must be distinguished by the first leg and the palpus.

We have one male from Arizona.

Pellenes coecatus Hentz.

1845. *Attus coecatus,* H.,♂. Jour. Bost. Soc. Nat. Hist., Vol. V.
1875. *Attus coecatus,* id.,♂. Coll. Hentz's Arachn. Writ., p. 65.
1888. *Habrocestum coecatum,* ♂. North Amer. Attidae, Peckham, p. 60.

♂. Length, 5 mm. Length of third leg, 6 mm. Legs, 3412. First leg longer than second by two-thirds of tarsus. Third leg longer than fourth by tarsus.

♂. Length, 4.3 mm. Length of third leg, 4.4 mm.

Quadrangle of eyes equally wide in front and behind. First row straight, middle eyes subtouching, lateral slightly separated from middle eyes, and rather less than one-half as large. Eyes of third row nearly as large as lateral eyes of first row, placed equally distant from each other and from lateral borders. Clypeus two-thirds as high as middle eyes of first row. Maxillae small, rounded. Labium very small, rounded, about as wide as long, less than half as long as maxillae. Anterior coxae separated by fully the width of the labium. Sternum oval. The femur of the first leg of the male has, at the distal end, two stout brushes of hair; and on the inner side of the tibia, two long flattened apophyses or strong spines; while the third leg has the distal end of the femur enlarged, and has, on the dorsal surface of the patella, a little ridge and a weak apophysis.

The cephalothorax is black, with some brownish hairs over the first row of eyes, and some white hairs on the thoracic part. The abdomen is black, more or less covered with whitish hairs, which form (sometimes not distinctly) a white basal band which extends on to the sides, a transverse curved white band across the middle, a central diamond-shaped white spot behind this, and two short white lines just above the spinnerets. The clypeus is covered with short, brilliant red hairs; where these are rubbed off it is brown. The falces are brown. The legs are brown, the first being the darkest. They all have blackish longitudinal bands on the femoral joints. The femur of the first has two stiff brushes of dark-colored hair, one on the anterior and one on the posterior side, toward the distal end. The patella and tibia of the first have a good deal of white rice-like hair, and the tibia has, on the anterior side, near the distal end, two black flattened spines. The femur of the third has, on the anterior face, at the distal end, a clear space with a black dot. The spines on the third leg are light-colored, excepting on the last two joints, where they are black. Palpus lighter brown than legs, with scanty white hairs on tarsus.

Habitat: Pennsylvania, New York, Alabama, New Mexico. (Prof. T. D. A. Cockerell.)

In the description of this species in our *North American Attidae,* the female sign was inadvertently substituted for that of the male. We have no female of *coecatus.*

Pellenes festus, n.

Pl. I, fig. 5.

♂. Length, 6 mm. Third leg, 6 mm. Legs, 3412. Third leg longer than second by tarsus and metatarsus. Third leg longer than fourth by tarsus.

Quadrangle of eyes slightly wider behind than in front. First row almost straight, eyes small, the middle about twice as large as the lateral; middle eyes subtouching; lateral separated from the middle by one-third their own diameter. Eyes of the third row about as large as the lateral eyes of the first row, placed as far from each other as from the lateral borders. Clypeus two-thirds as high as middle eyes of first row. Maxillae wedge-shaped, slightly rounded in front, inclined toward each other. Labium a little longer than wide, half as long as maxillae. Sternum large, oval. Anterior coxae separated by the width of the labium. Tibia of first leg with two long stiff spines or apophyses. Femur and patella of third leg each with an apophysis at distal end.

The cephalothorax is black, probably covered with a mixture of short white and yellow hairs. In our specimen there remain, of these, a good many on the thoracic part, while the eye-region is thickly covered. There are also some long, darker colored hairs over the first row of eyes. The abdomen is black, surrounded by white, with a white longitudinal central band, a curved transverse white band coming up from the sides over the middle of the dorsum, and two white bars at the spinnerets. Clypeus white. Falces brown with sparse white hairs.

Legs brown, the first being a little darker than the others, and having two longitudinal black lines on the upper face of the tibia. On the under side of the posterior face of the femur, patella, and tibia of the first, is a fringe of long white hairs; and on the under side of the anterior face of the same joints is a similar, but less pronounced fringe. The third leg has the anterior face of the femur pale, with two longitudinal dark lines, while at the distal end is a pale space having in the center a black dot. This pale space is in a constricted part, and a small apophysis comes off just above. All the spines on the third leg are light-colored.

From Utah. This species is close to *coecatum,* the leg modifications being very similar. *Coecatum,* however, has, on the distal end of the anterior face of the tibia of the first leg two large, flattened black spines; and has also, on the anterior and posterior faces of the femur of the first, toward the distal end, two stiff brushes of dark-colored hair; while the first leg in *festus* is as above described, adorned with fringes of white hair. Moreover in *coecatus* the clypeus is red, while in *festus* it is white.

Pellenes Klauserii, n.

Pl. I, fig. 6.

♂. Length, 4.5 mm. Legs, 3412.

Quadrangle of eyes wider behind, and nearly one-third wider than long. First row of eyes straight, the middle near together, the lateral a little separated, the latter less than half the former. Second row nearer the first than the third. Clypeus equal to diameter of middle eyes. Labium as wide as long, and half as long as maxillae. The sternum light yellow. The first leg has fringes of hairs, but they are not so long as in *H. brunneus,* or the other species with these ornaments. The femur has fringes on the two sides, while on the patella and tibia, although there are hairs on the anterior sides, it is only on the posterior that they are well marked; the hairs on the upper side of the femur are dark, the others white. Two long, thick, black spines come off from the anterior face of the tibia. The third leg is modified; the femur, near its distal end, is constricted, the part beyond being somewhat enlarged and rounded; on the face of this part is a black spot, and above it is a black ridge. The patella has two apophyses on its upper side.

The cephalothorax is black. The clypeus and face of falces are covered with white hairs. White lines, rather narrow, extend back along the margin, and on reaching the posterior end turn upward, as in other species of this genus, and merge with fawn-colored hairs that cover the cephalic plate. In some specimens all these markings are fawn-colored.

The abdomen is black, with a basal band running down the sides, and a second transverse band, narrower than the first, the two united, along the middle, by a wide band; the posterior part of the abdomen has a median line of short chevrons reaching the spinnerets. On each side of this line, just above the spinnerets, are spots. All these markings may be made up of white, or of fawn-colored hairs. The under side of the abdomen is without markings. The three posterior legs are covered with hairs; on the femur of the third leg there are two black lines, with lighter lines edging them, and on the constricted part there is often a tinge of red.

We have two males from New Mexico, from Prof. T. D. A. Cockerell.

Pellenes limatus, n.

Pl. I, fig. 7.

♂. Length, 6.5 mm. Legs, 3412; the first scarcely stouter than the others.

The quadrangle of the eyes occupies only a little more than one-third of the cephalothorax, is barely one-fourth wider than long, and is only a very little wider behind than in front. The front eyes form a curved row; the middle eyes are subtouching, and fully twice as large as the lateral, which are separated from them.

The sides of the cephalothorax, and the middle upper part, are covered with yellow hairs. Two white bands run from above the lateral eyes to the posterior end. These are met by white marginal bands, which begin at the dorsal eyes and pass backward. The abdomen is white, with two longitudinal bands of yellow hairs, which have on their edges, in the posterior part, a series of darker bars, giving them a jagged appearance. The clypeus is covered with yellow hairs. The falces are brown. The tibia of the first leg is dark, but otherwise the legs and palpi are yellow, covered thickly with white hairs.

We have a single male from California.

Pellenes Birgei, n.

Pl. I, fig. 8.

♂. Length, 5 mm. Legs, 3412.

Quadrangle of eyes slightly wider behind, and one-quarter wider than long. First row of eyes straight, middle touching, and lateral eyes a little separated; the middle eyes are twice as large as the lateral. Second row about halfway between the others. Clypeus two-thirds as high as the middle eyes. The first leg has a fringe of moderately long hair on the upper side of the femur, patella and tibia, pure white on the femur, not so white on the other joints; on the under side of the same articulations there is also a fringe, which is dark in color, and not quite so long. Labium as long as wide, and nearly half as long as maxillae.

The clypeus is white with some fawn-colored hairs under the middle eyes which reach on to the upper part of the falces. The white of the clypeus extends in a band along the lower margin of the cephalothorax, passes up behind the dorsal eyes, and is continued forward, more or less distinctly, to the anterior lateral eyes. The cephalic plate and the sides are fawn-colored. The sides and base of the abdomen, and a median longitudinal band are white, and the other parts reddish-brown. The legs and palpi, excepting the tarsi, are covered with short white hairs.

We have one male sent to us by Prof. Cockerell, from Mesila Park, New Mexico.

Pellenes Townsendii, n.

Pl. I, fig. 9.

♀. Length, 5.5 mm. Legs, 3412, first a little the stoutest.

The quadrangle of the eyes is one-fourth wider than long, and a little wider behind than in front. The front eyes are all plainly separated and form a strongly curved row, the middle being twice as large as the lateral. The second row is halfway between the other two. The third row is not so wide as the cephalothorax. The clypeus is two-thirds as wide as the middle eyes. The labium is more than half as long as the maxillae, which are rounded.

The cephalothorax is covered with fawn-colored hairs. There is a white band running from the clypeus up between the middle eyes, and then backward on the cephalic part, widening as it goes, until it fills all the space between the dorsal eyes. There is a white band around the margin, which is joined behind by two white bands which run from the lateral eyes along the upper sides, and downward on the thoracic slope. The face is very striking. The first row of eyes is strongly curved, and from the outer side of each of the large middle eyes a broad brown streak runs outward and obliquely downward. The two middle eyes are separated by white hairs, which also cover the middle part of the clypeus and the spaces under the lateral eyes. The falces are brown and vertical. The abdomen has a fawn-colored region on each side of the dorsum, a white encircling band, which is jagged on the inner side, and, down the middle, a white band which is made up of a series of blunt arrowheads, which point forward. The palpi and legs are brown, with black spines and white hairs, the first legs being the darkest.

While in the marking of the clypeus this species bears a strong resemblance to *carolinensis* and *sabulosus, Townsendii* is distinct from them by the median longitudinal white band running throughout the length of the abdomen.

We have one female from Texas, sent to us by Mr. Townsend.

Pellenes carolinensis, n.

Pl. I, figs. 10-10b.

A distinctly marked, black and salmon-colored species.

♀. Length, 5.5-7 mm. Legs, 3412, first and second a little stouter than the others.

The quadrangle of the eyes is equally wide in front and behind, and is one-third wider than long. The front row is straight, with the middle eyes subtouching, and twice as large as the lateral, which are separated from them. The maxillae are rounded, and are more than twice as long as the labium. The clypeus is two-thirds as wide as the middle eyes.

The hairs on the cephalic part are bright yellowish-red over the first row of eyes, and silvery further back. There is a scalloped, salmon-colored band behind the dorsal eyes. The lower margin has a black line between two white lines. In our specimens the other parts of the cephalothorax are rubbed bare, excepting the clypeus, which is white in a band along the margin, in a large spot under each lateral eye, and in a narrow band which begins just between the middle eyes, and widens as it passes downward to the margin, and which has an oblique chestnut-colored band running outward from below each of the middle eyes. The abdomen is velvety black, with markings of a bright pinkish and salmon-color, there being a wide transverse band near the front end, an oblique band on each side, further back, two oblique marks in the middle and two irregular, sometimes continuous spots on the posterior part of the dorsum, and two dots near the spinnerets. The pattern is complicated by a sprinkling of salmon-colored hairs, which surround the posterior part of the dorsum. The legs are yellowish, and are covered with white and salmon-colored scales.

Carolinensis bears a general resemblance to *viridipes* but is distinguished by the chestnut-colored hairs on the clypeus.

We have several females from Charleston, S. C.

Pellenes sabulosus, n.

Pl. I, figs. 5, 11-11a.

A very dark species, with indistinct markings.

♀. Length, 6-8 mm. Legs, 3412.

The quadrangle of the eyes is equally wide in front and behind, and is one-fourth wider than long. The front row of eyes is slightly curved, the middle eyes being slightly separated and not quite twice as large as the lateral, which are further from them than they are from each other. The clypeus is a little more than one-half as wide as the middle eyes. The maxillae are twice as long as the labium, and are rounded.

The integument of the cephalothorax is black, with a short covering of yellow hairs. There are wide white bands on the sides, which unite behind, but do not run up on to the thorax. The margin has a black line between two white lines. The clypeus is much like that of *carolinensis* but lacks the white margin. It has a white spot in the middle, running from between the middle eyes to the falces, and an oblique chestnut-colored spot passing outward from under each of the middle eyes to the margin. Above these, below the lateral eyes, it is white. The abdomen is black, mottled with gray, with a lighter basal band running on to the sides. There are two pairs of gray spots on the anterior part of the dorsum and a central gray spot further back. Near the spinnerets are two snow-white dots. The legs have the coxae and trochanters yellow, contrasting strongly with the other joints, which are dark, with many white hairs. The front faces of the falces are thinly covered with white hairs. The under parts are light gray.

We have several females from Georgia.

Pellenes simplex, n.

Pl. I, fig. 12.

♀. Length, 5.5 mm. Legs, 3412, first and second stoutest.

The quadrangle of the eyes is slightly wider behind than in front, and is one-third wider than long. The front eyes are all separated and form a curved row, the middle being twice as large as the lateral. The maxillae are more than twice as long as the labium, and are wide, and slightly rounded. The clypeus is nearly as wide as the middle eyes.

The cephalic plate is covered with short yellow hairs and a thin growth of long black hairs; on the sides of the cephalothorax the hairs are white, and the lower margin has a black line between two white lines. The upper thoracic part, in our single specimen, is rubbed bare. The abdomen has gray hairs around the base and sides, and in an irregular band down the middle, and a dark band on either side which becomes black where it forms the scalloped outline of the gray side bands. The legs and palpi are yellow, with white hairs. The clypeus and the spaces between the eyes are covered with yellowish-white hairs, and the reddish-brown falces have white hairs growing thinly over their front falces.

We have one female from Vera Cruz, Mexico.

Pellenes griseus, n.

Pl. I, fig. 13.

A yellowish-gray species.

♀. Length, 6 mm. Legs, 3412.

The quadrangle of the eyes is wider behind than in front, is one-third wider than long, and occupies scarcely more than one-third of the cephalothorax. The front row of eyes is nearly straight. The middle eyes are subtouching, and are twice as large as the lateral, which are separated from them. The clypeus is nearly as wide as the middle eyes. The maxillae are more than twice as long as the labium, and are rounded.

The cephalothorax is covered with gray hairs, the margin having a black line between two white lines. The clypeus is covered with white hairs. The abdomen is gray, with a central white band on the posterior part, on the sides of which are oblique chestnut-colored bars. The legs are yellow, with gray hairs.

We have a single female from Utah.

Pellenes candidus, n.

Pl. I, fig. 14.

♀. Length, 6.5 mm. Legs, 3412.

The quadrangle of the eyes is one-fourth wider than long, and is equally wide in front and behind. The anterior eyes are all separated, and form a straight row, the middle being twice as large as the lateral. The clypeus is three-fourths as high as the middle eyes.

Under alcohol the spider is of a pale yellowish color, the eye-region being darker than the rest, with an indistinct, light, herring-bone stripe on the abdomen. When dry, the upper surface of the cephalothorax, and the entire abdomen, above and below, are closely covered with yellowish-gray hairs, giving a pale golden tint, with scattering, long, black hairs over all. There are white hairs on the sides and posterior thoracic slope of the cephalothorax. The clypeus and the spaces between the eyes have long white hairs, which are also found on the palpi. The falces are brown with a few white hairs, and the legs reddish, with white scales.

We have one female from Salt Lake City, Utah.

Pellenes nemoralis, n.

Pl. I, fig. 15.

♀. Length, 5.3 mm. Third leg, 5 mm. Legs, 3412. First leg longer than second by tarsus and metatarsus. Third leg longer than fourth by tarsus.

Quadrangle of eyes a little wider behind. First row slightly curved, middle eyes of first row a little separated; lateral separated from the middle eyes by fully two-thirds of their own diameter; middle not quite twice as large as the lateral eyes. Eyes of the third row a little smaller than the lateral eyes of the first row, placed a little further from each other than from the lateral borders, on the margin of the cephalothorax. Clypeus two-thirds as high as the middle eyes of the first row. Maxillae nearly square, truncated in front, straight on the inner edges. Labium as wide as long, more than one-half as long as maxillae. Anterior coxae separated by a little more than the width of the labium. Sternum oval. General color brown. This specimen has the eye-region covered with white and copper-colored hairs, and has patches of the same on the abdomen, where, however, they are nearly all rubbed off, leaving pale chevrons and mottlings visible. Clypeus covered with thick white hairs. Falces brown, with some white hairs. Legs light brown, with some light-colored and white hairs. Habitat: Arizona.

See remarks under *superciliosus* and *dolosus*.

Pellenes superciliosus, n.

Pl. I, fig. 16.

♀. Length, 7 mm. Third leg, 5.4 mm. Legs, 3412. First leg longer than second by tarsus and a little of metatarsus. Third leg longer than fourth by tarsus and metatarsus.

Quadrangle of eyes a little wider behind. First row slightly curved, with the middle eyes a little separated, and the lateral separated from the middle by one-half their own diameter; middle twice as large as lateral eyes. Above the eyes of the first row is a ridge of upright black hairs, thickest and longest in the middle. Eyes of the third row as large as lateral eyes of the first row, and equally distant from each other and the lateral borders. Clypeus about as high as middle eyes of first row. Maxillae rounded in front and on inner edges. Labium about as wide as long, one-half as long as maxillae. Sternum oval. Anterior coxae separated by less than the width of the labium.

Cephalothorax covered with a mixture of short white and red hairs. Abdomen, in this specimen, showing a few similar hairs at the spinnerets, but otherwise rubbed bare, the integument being reddish-brown, with chevrons, oblique bands on the sides, and many small spots, pale. Clypeus covered with white hairs. Falces brown with sparse white hairs. Legs light yellowish, barred with blackish.

Habitat: Arizona.

Distinguished from *dolosus* and *nemoralis* by the upright hairs over the first row of eyes.

Pellenes politus, n.

Pl. I, fig. 17.

♀. Length, 6.5 mm. Legs, 3412, first and second stoutest.

The quadrangle of the eyes is a little wider behind than in front, and is one-fourth wider than long. The front eyes are in a straight row, the middle subtouching and fully twice as large as the lateral, which are a little separated from them. The clypeus is two-thirds as wide as the middle eyes. The maxillae are more than twice as long as the labium, and are rounded.

The whole body is thinly covered with a mixture of white and rufus hairs. On the cephalic part are three longitudinal white bands. The sides of the cephalothorax are white, and the margin has a black line with a white line below it. The abdomens of our specimens are badly injured, showing only a white basal band, and two white spots near the spinnerets. The hairs around the front middle eyes are rufus above and below, and white on the sides. The middle of the clypeus has a large snow-white triangle, the apex being above, and the broad base covering the margin. Running obliquely outward from below the middle eyes, are two chestnut-colored bars, and outside of these, running from between the lateral and middle eyes, two oblique snow-white bands. Just under each lateral eye is another short chestnut-colored streak. The legs are brown with white hairs.

We have two females from New Mexico, sent us by Prof. Cockerell.

Pellenes placidus, n.

Pl. I, fig. 18.

♀. Length, 7 mm. Legs, 3412.

Quadrangle of eyes plainly wider behind, and one-third wider than long. First row of eyes straight, all touching, the middle fully twice as large as the lateral. The second row is halfway between the other two. Clypeus very nearly as high as the middle eyes. Labium as wide as long, and about one-half the length of the maxillae. The sternum is light brown.

The cephalothorax is entirely covered with fawn-colored hairs. Along the lower margin, but not passing over the clypeus, is a narrow black line. The sides of the abdomen are covered with fawn-colored hairs; along the middle is a light-colored band that reaches neither the apex nor base; the band is of irregular outline. On each side of the band, the abdomen is dark brown. All the legs are yellowish-brown, with many white hairs.

We have one female from Chihuahua, Mexico.

Pellenes cognatus, n.

Pl. I, fig. 19.

♀. Length, 6 mm. Legs, 3412, first a little the stoutest.

The quadrangle of the eyes is wider behind than in front, and is one-third wider than long. The front eyes are all separated, and form a straight row, the middle being plainly twice as large as the lateral. The second row is halfway between the other two. The third row is not so wide as the cephalothorax. The labium is wider than long, and half as long as the maxillae. The clypeus is one-half as wide as the middle eyes. The cephalothorax and abdomen are covered with a close mixture of fawn-color, white and black, the white predominating to form three longitudinal bands on the cephalic part, one down the middle, and one on each side, an encircling band on the abdomen, and a band of three white chevrons, or arrow-heads, in the middle of the dorsum, this band reaching neither extremity. On the margin of the cephalothorax is a narrow line of black. The eyes are surrounded by yellowish-white hairs, which also cover the clypeus. Under each of the middle eyes, at the outer edge, there is a spot faintly tinged with chestnut, which passes downward to the black marginal line. The legs and palpi are light brown, thickly covered with white hairs. The falces are brown.

This species is much like *placidus,* from Mexico, but the shield to the opening of the epigynum is not widened in front. The whitish bands on the cephalic part, and around the abdomen, and the spots on the clypeus, also serve to distinguish it.

We have two females, one from Kansas, and one from New Mexico, sent to us by Prof. T. D. A. Cockerell.

Pellenes dolosus, n.

Pl. I, fig. 20.

♀. Length, 7.5 mm. Third leg, 5.5 mm. Legs, $3\overline{41}2$. First leg longer than second by tarsus and metatarsus. Third leg longer than fourth by tarsus and metatarsus.

Quadrangle of eyes a little wider behind. First row straight, with all the eyes subtouching; middle fully twice as large as the lateral and projecting. Eyes of the third row as large as the lateral eyes of the first row, placed a little further from each other than from the lateral borders. Clypeus one-half as high as middle eyes of first row. Maxillae as wide as long, truncated in front, rounded on inner sides. Labium fully as wide as long, less than one-half as long as maxillae. Anterior coxae separated by about the width of the labium. Sternum oval.

Cephalothorax blackish, pretty generally covered with short white hairs. The abdomen in this specimen has the hairs almost entirely rubbed off, only a few white ones remaining at the base. The integument is blackish, with pale chevrons and mottlings. Clypeus thickly covered with white hairs. Falces brown. Legs and palpi, light brown, the first legs being a little darken than the others, with some light-colored and white hairs. Habitat: Arizona.

Distinguished from *nemoralis* by the eyes of the first row, which in this species are all subtouching, and form a straight row, while in *nemoralis* they are separated and form a curved row.

Poultonia, gen. nov.

Pl. II, figs. 1-1b.

Small spiders. The cephalothorax is rather high, not much longer than wide. Sides nearly parallel and vertical, highest at dorsal eyes from which point it slants in both directions.

The quadrangle of eyes is one-fifth wider than long and is wider in front. The first row of eyes is a little curved, and the cephalic slant is so great that these eyes look down; the middle are subtouching, the lateral are a little separated. All the eyes of this row are large, the lateral being four-fifths as large as the middle, the eyes of the second row are about halfway. The dorsal eyes are as large as the lateral, are as wide as the cephalothorax at that place, and stand out distinctly. The quadrangle occupies one-half of the cephalothorax. The thoracic plate slants slightly in its first half and thereafter abruptly. The abdomen is small; the upper spinnerets are very long, almost equalling in length the abdomen. Legs, $4\overline{3}1\overline{2}$, all slender.

This genus is founded on a spider from South America, *P. caudata*, and is named for our friend, Prof. E. B. Poulton of Oxford University.

Poultonia caudata, n.

Pl. II, figs. 1-1c.

Small spiders with spinnerets nearly as long as the abdomen.

♂. Length, 3.5 mm. Legs, $\overline{4}3\overline{12}$, all slender.

The cephalothorax has the cephalic part covered with fawn-colored, and the thoracic with grayish-brown hairs. The abdomen has grayish-brown hairs, which show reddish metallic reflections when thoroughly dried. It is probable that the cephalothorax also had metallic coloring, in life. The upper spinnerets are covered with grayish-brown hairs except at the end, where they are enlarged and black. The legs are all yellow. The femur of the first has a black, longitudinal band, and the tibia and metatarsus have each two longitudinal black lines. Nearly all the joints of the other legs have longitudinal black lines with some additional oblique ones on the femur of the third and of the fourth. The clypeus is nearly as wide as the large middle eyes, and has two transverse white bands with a narrow black line between them. The palpi are yellow with white hairs, and have the under side of the distal end of the femur black with a bunch of black hairs. The patella has a black ring at the distal end. The falces are vertical and rather weak.

We have several males from Chapada and Sao Paulo, sent to us by Mr. Moenkhaus.

Grauhara, gen. nov.

Pl. II, figs. 2-2b.

This genus, which belongs to the Homalattus Group, is distinguished by its slender shape and elongated first legs.

The cephalothorax is moderately high and is two-thirds as wide as long. It is narrow in front, but bulges out at the dorsal eyes. The sides are nearly vertical. The cephalic part is a little inclined forward, and the thoracic drops almost immediately behind the dorsal eyes. The quadrangle of the eyes occupies a little more than half of the cephalothorax, is one-fifth wider than long, and a little wider in front than behind. The front eyes are all close together in a straight line, the middle ones being plainly more than twice as large as the lateral, and bulging forward. The second row is nearer the first than the third, and the third is nearly as wide as the cephalothorax. The first legs are elongated. The falces are horizontal and short. The maxillae are rounded, and the labium is small.

Grauhara vivida, n.

Pl. II, figs. 2-2d.

This is a graceful species with brown and white coloring. It is readily distinguished by the large eyes of the first row, and by the shape of the fangs, which are notched on the outer side.

♂. Length, 4 mm. Legs, 1423, the first much elongated, with the coxa and trochanter reaching to within a third of the distal end of the femur of the second.

The cephalothorax is brown with the eye-region covered with white hairs, and two small spots of white on the posterior slope of the thorax. The abdomen is brown, the posterior fifth being much darker than the rest, the two color regions being marked off sharply. A white band runs along each side, ending abruptly where the color darkens, and just above the spinnerets there is a white spot. The legs are not at all hairy. The first pair is brown, elongated, and somewhat thickened; the others are slender, rather short, and pale yellow. The palpi are rather long, and are pale brown in color. The falces are brown, and are short, horizontal and wide, the width at the end being equal to the length. There is a wide apophysis at the distal end, on the inner side, upon which is a small tooth. The fang has a notch on the outer side of the proximal end.

We have one male from Santarem, Brazil, sent to us by Mr. Moenkhaus.

Irura, gen. nov.

Pl. II, figs. 3-3b.

This very distinct genus belongs to the Homalattus Group, being most closely allied to *Rhene,* but differing from that genus in having the upper surface of the cephalothorax flat, and a wider quadrangle of the eyes.

Both cephalothorax and abdomen are short, wide and rounded, the cephalothorax being plainly wider than long and widest behind the dorsal eyes. It is very low, and is perfectly flat on top. The sides are nearly vertical. The quadrangle of the eyes occupies slightly more than half of the cephalothorax, is twice as wide as long, and is plainly wider behind than in front. The front middle eyes are close together, the lateral being separated from them, and about half as large. This first row is straight. The second row is plainly nearer the first than the third, and the third is not quite so wide as the cephalothorax. The falces are short, vertical, robust and slightly divergent. The first legs have the joints thickened.

Irura pulchra, n.

Pl. II, figs. 3-3c.

Small spiders, covered with pinkish iridescent scales. The femur of the first leg is iridescent steel blue, with a fringe of white hairs.

♀. Length, 4 mm. Legs, 1423.

The cephalothorax is dark colored with a covering of brilliant pinkish iridescent scales. The ground-color of the abdomen is pale yellow, with two pairs of darker spots, the posterior pair being larger than the others and placed in the middle of the dorsum. The whole is covered with iridescent scales, those on the central part being golden, while around the edges they are pink and green. The first legs and the palpi have the joints thickened with a covering of pinkish iridescent scales. The femur of the first leg, on the front, or inner side, is iridescent steel-blue, with a thin fringe of white hairs. The patella is as long as the tibia, and both of these joints have a thin fringe of brown hairs on the inner side. The other legs are yellow.

One female from Ceylon, sent to us by Rev. O. P. Cambridge.

Tacuna, gen. nov.

Pl. II, figs. 4-4b.

This genus differs from *Rhene* in having the cephalothorax low and flat, and the quadrangle of the eyes only a quarter wider than long. In *Irura* it is twice as wide as long.

The cephalothorax is low and flat, and is as wide as long, the widest point being at the dorsal eyes. The thoracic part is truncated, and the sides are almost vertical. The quadrangle of the eyes occupies two-thirds of the cephalothorax, is one-fourth wider than long, and is very much wider behind than in front. The first row of eyes is very slightly bent downward. The middle eyes are close together and are about twice as large as the lateral, which are slightly separated from them. The second row is nearer the first than the third. The third row is nearly as wide as the cephalothorax. The relative length of the legs is 1423, the first being much the longest.

Tacuna delecta, n.

Pl. II, figs. 4-4c.

Small brown spiders with the tibia of the first leg nearly as wide as long, and bearing a stiff ridge of hairs. Metatarsus and tarsus of the first leg very slender.

♂. Length, 3 mm. Legs, 1423, the first much the longest, with the femur and tibia enlarged.

The whole spider is brown, the cephalothorax being much darker than the abdomen. It seems to have been covered with white hairs, but in our single specimen these are nearly all rubbed away excepting on the sides of the cephalothorax, where they grow rather thinly, with the points directed upward. On the abdomen are three pairs of black dots. The first leg is much enlarged. There is nothing conspicuous on the femur and patella, but on the under side of the tibia there is a stiff spiny ridge of black hairs. The metatarsus and tarsus are very slender. All the legs are yellowish brown. The falces project very slightly forward, and are delicate and tapering, with rather long fangs, and toothed apophyses on the inner sides. The labium is wide and the maxillae are rounded.

We have one male from Rio Janeiro, sent to us by Mr. Moenkhaus.

Homalattus hispidus, n.

Pl. II, figs. 5-5a.

This species is very distinct through the ornamental hair tufts at the anterior end of the abdomen, but is difficult to place generically since it goes almost equally well into *Homalattus* and *Beata*, while it agrees perfectly with neither.

♀. Length, 7 mm. Legs, 1423, not very different in length, the first stoutest.

The widest point of the cephalothorax is at the dorsal eyes. The cephalic part is a little inclined, while the thoracic falls slightly in the first half and then abruptly, the posterior slope being truncated. The quadrangle of the eyes occupies about one-half of the cephalothorax, is one-third wider than long and is plainly wider behind than in front. The front eyes are in a straight row, the middle touching and less than twice as large as the lateral which are a little separated from them. The second row is nearer the first than the third.

The cephalothorax is golden brown. Above the first row of eyes are five tufts of hairs, the middle and the two external ones being white, while the other two are reddish-brown. From the lateral eye, on each side, a band of white hairs runs to the posterior end, the hairs lengthening into a white tuft behind each dorsal eye. The abdomen is yellow with a mottled pattern of spots and chevrons in white, which may be best understood by the illustration. At the anterior end are three tufts of stout yellow hairs, and behind these are two tufts of yellow hairs with little bunches of black hairs above them. When not perfectly dry these hairs form an untidy mass as in the drawing. The clypeus is covered with white hairs. The falces are brown, with an oblique band of white hairs across the front face, and a fringe of white hairs at the end. The palpus has long white hairs on the tibia and tarsus. The legs are brown and are short and stout.

We have one female from San Rafeal, Mexico, sent to us by Mr. Tyler Townsend.

Explanation of Plates.

Plate I.

Fig. 1, *Pellenes Howardii,* dorsal view of male, × 8; 1a, palpus; 1b, epigynum.
Fig. 2, *P. brunneus,* palpus.
Fig. 3, *P. elegans,* palpus.
Fig. 4, *P. tranquillus,* palpus.
Fig. 5, *P. festus,* palpus.
Fig. 6, *P. Klauserii,* palpus.
Fig. 7, *P. limatus,* palpus.
Fig. 8, *P. Birgei,* palpus.
Fig. 9, *P. Townsendii,* epigynum.
Fig. 10, *P. carolinensis,* dorsal view of abdomen of female; 10a, face of female; 10b, epigynum.
Fig. 11, *P. sabulosus,* face of female; 11a, epigynum.
Fig. 12, *P. simplex,* epigynum.
Fig. 13, *P. griseus,* epigynum.
Fig. 14, *P. candidus,* epigynum.
Fig. 15, *P. nemoralis,* epigynum.
Fig. 16, *P. superciliosus,* epigynum.
Fig. 17, *P. politus,* epigynum.
Fig. 18, *P. placidus,* epigynum.
Fig. 19, *P. cognatus,* epigynum.
Fig. 20, *P. dolosus,* epigynum.

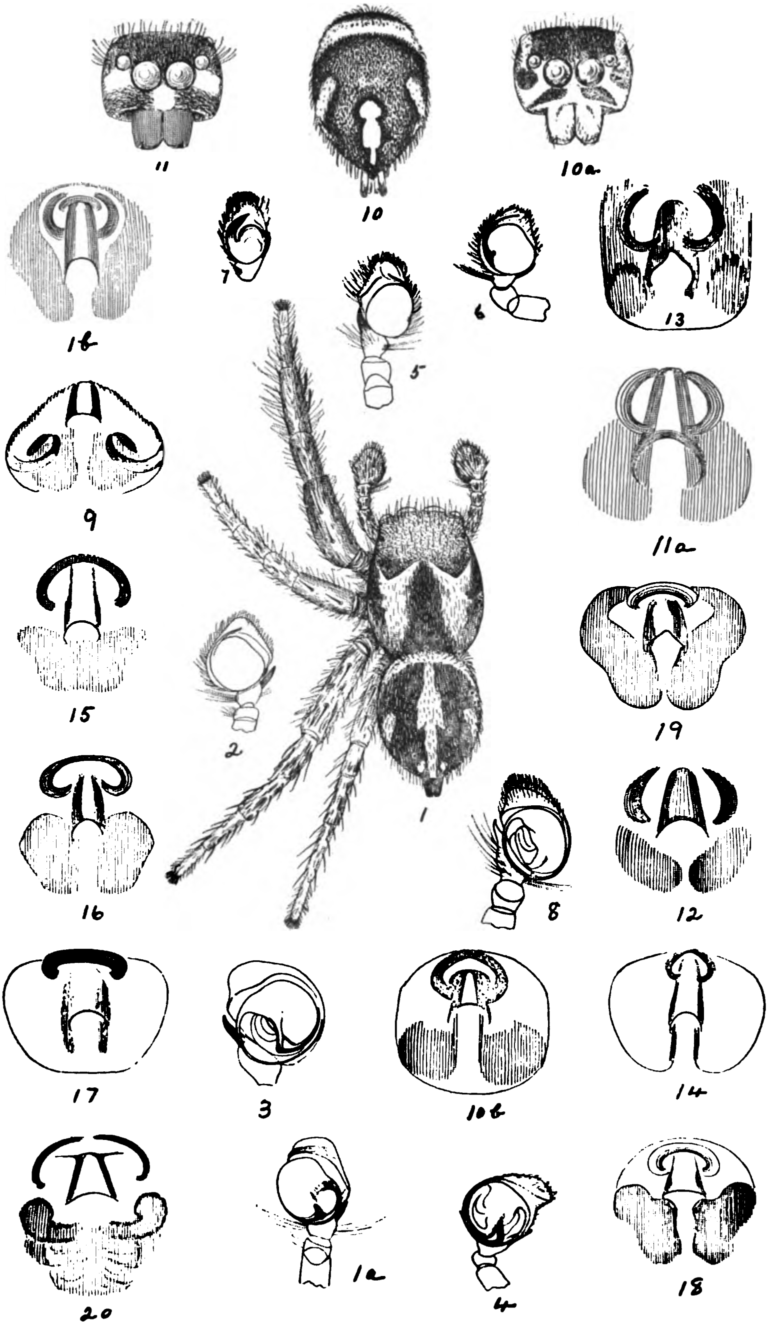

PLATE I.

Plate II.

Fig. 1, *Poultonia caudata,* dorsal view of male, × 8; 1a, side view of cephalothorax of male; 1b, face of male; 1c, palpus.

Fig. 2, *Grauhara vivida,* dorsal view of male, × 8; 2a, side view of cephalothorax of male; 2b, face of male; 2c, ventral view of palpus; 2d, side view of palpus.

Fig. 3, *Irura pulchra,* dorsal view of female, × 8; 3a, side view of cephalothorax of female; 3b, face of female; 3c, epigynum.

Fig. 4, *Tacuna delecta,* dorsal view of male, × 8; 4a, side view of cephalothorax of male; 4b, face of male; 4c, palpus.

Fig. 5, *Homalattus hispidus,* dorsal view of female, × 8; 5a, epigynum.

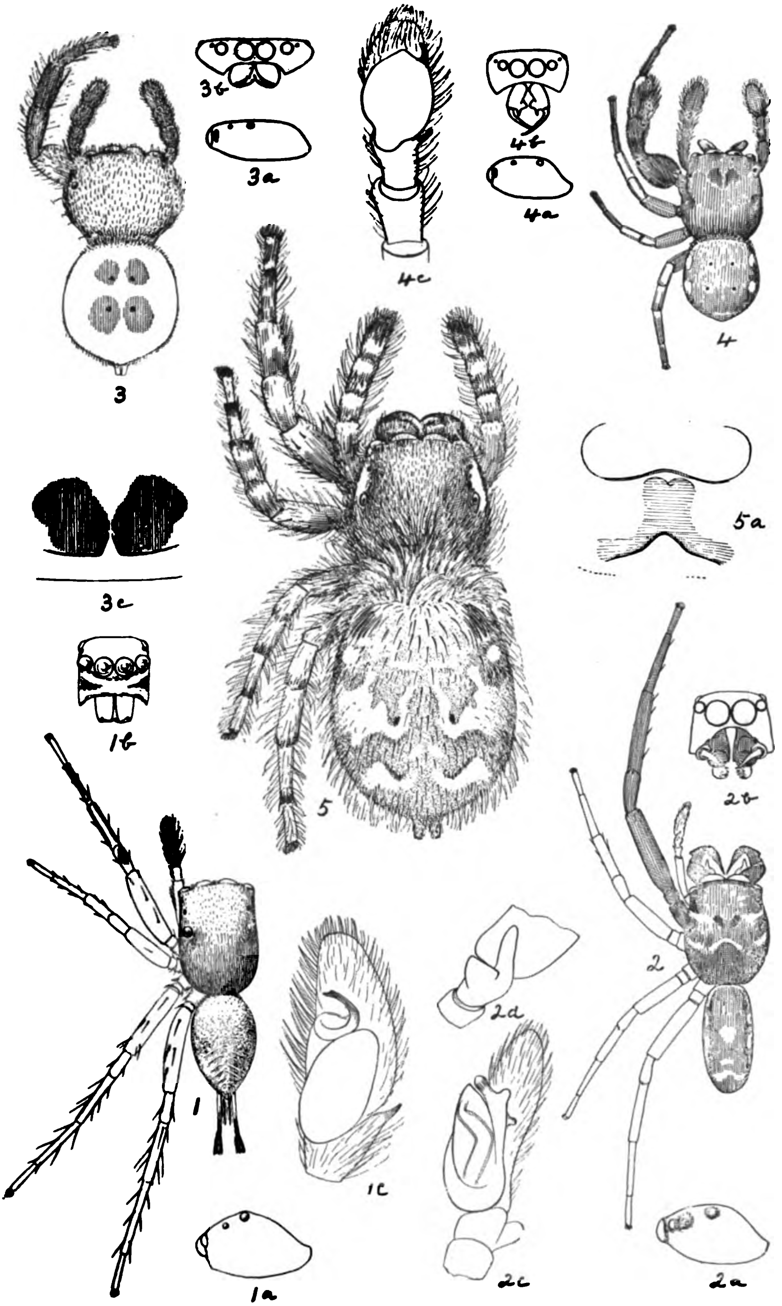

PLATE II.

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VOLUME II

(NEW SERIES)

WITH TWELVE PLATES

MILWAUKEE
1902

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14,425

OF THE

WISCONSIN NATURAL HISTORY SOCIETY

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MILWAUKEE, WISCONSIN.

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A

The Wisconsin Natural History Society,

MILWAUKEE, WIS.

ORGANIZED MAY 6, 1857.

OFFICERS.

EDGAR E. TELLER—PRESIDENT..................3303 Cedar Street, Milwaukee
DR. S. GRAENICHER—VICE PRESIDENT.....551 Seventh Street, Milwaukee
W. J. BENNETTS—GENERAL SEC'Y....413 Twenty-third Street, Milwaukee
LEE R. WHITNEY—COR. SEC'Y...........Room 225, P. O. Bldg., Milwaukee
GEO. A. WEST—TREASURER...................2828 Highland Bl'vd, Milwaukee
A. BIERSACH—LIBRARIAN................................Public Museum, Milwaukee

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Secretary of Sections,	C. E. Brown	Geology,	C. E. Monroe
Archeology,	W. H. Ellsworth	Ornithology,	Edw. E. Voss
Numismatics,	W. F. Sandrock	Entomology,	C. E. Brown
Botany,	E. Bruncken	Mineralogy,	Louis Lotz

REGULAR MEETINGS.

(1) These are all held in the Society's lecture room in the Museum-Library Bldg., Milwaukee.

(2) Meetings of the combined sections take place on the 2nd Thursday of each Month, at 8 P. M.

(3) The Archeology and Numismatics sections meet on the 3d Thursday of each Month.

(4) General meetings are on the last Thursday of each Month except July and August.

(5) Meetings of the Archeologists and collectors of the State are to be held semi-annually under the direction of the Archeology section, for the purpose of furthering the cause of Wisconsin Archeology.

PUBLICATIONS.

(1) The "Bulletin of the Wisconsin Natural History Society"—a 64 page octavo publication issued quarterly. Editor, W. J. Bennetts.

(2) The "Wisconsin Archeologist," published by the Archeology section. Editor, C. E. Brown.

MEMBERSHIP DUES.

Local Members, $3.00 per annum; Non-resident Members, $1.00 per annum; Life Members, one payment of fifty dollars.

FEB . 1 1902

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 2, New Series. **JANUARY, 1902.** **No. 1.**

Proceedings of the Wisconsin Natural History Society.

September 27, 1900 to October 31, 1901.

Thursday, Sept. 27, 1900.

Twenty-four persons were present at this meeting, which was held in the lecture room of the Public Museum. President Teller occupied the chair.

Chas. E. Brown as secretary of sections read an interesting report on the work done at the union section meetings during the three preceding months, and concluded by dwelling at some length upon the benefits to be derived from attending these meetings.

Dr. Peckham then drew attention to a card index of publications on the flora and fauna of Wisconsin that he was then at work upon and promised to describe it at greater length at a future meeting.

The resignation of Paul H. Dernehl as librarian was accepted and Mr. Paul Rhode elected to the vacancy.

John H. Fiebing and Adolph Biersach were elected members of the society and Prof. Wm. H. Wheeler of the University of Texas an honorary member.

John A. Brandon then read a paper on local ornithology that revealed a deep interest in, and much patient observation of the birds. All of the common visiting and migratory species were considered in the order of their appearance and departure, and the habits of many of them—particularly of the horned lark, the sapsucker and the purple martin—were described at considerable length.

A paper written by Paul H. Dernehl on the Purple Martin (*Progne subis Bd.*) was read by Chas. E. Brown. For many years past martins have each year occupied bird houses set out for their use at the home of Mr. Dernehl, and his paper was chiefly based upon notes he has taken during the past six years upon their breeding and other habits.

The meeting was then adjourned.

THURSDAY, Oct. 25, 1900.

This meeting was held in the Museum lecture room with President Teller in the chair and thirty persons present.

Chas. E. Brown reported on a meeting of the united sections of the society held Oct. 11, and also on a meeting of the Archeology Section at the home of Mr. Henry R. Denison.

Mr. F. M. Benedict then addressed the meeting on the "Earthworks and Other Traces of Pre-historic Man Existing in Waupaca County, Wis."

After describing the topography and geological character of the region, with its underlying formations of granite and Potsdam sand, the speaker described the principal ancient village-sites, Indian trails and groups of mounds of the "Chain o' Lakes" district with which he was most familiar. The village sites were marked by numerous kitchen-middens from which little had been obtained except broken pottery and broken cobblestones, the latter bearing evidence of having once been employed when heated to boil water for the ancient villagers.

The speaker estimated the ancient cornfields to be fully 350 years old, basing his views upon the remains of trees that rested upon the ancient cornhills.

The principal mounds in that region were stated to be, (1) six effigy mounds of the turtle form that had contained encysted skeletons in a sitting posture, (2) a man mound 400 feet long, (3) a group of seven oblong mounds and (4) about 46 round mounds scattered throughout the district under consideration.

Two prehistoric excavations in the vicinity of the lakes were also described.

Dr. Stanhope, Rev. O. G. McNeill and C. E. Brown took part in a discussion that followed this address.

The following were nominated for membership by Mr. Nehrling and President Teller, and duly elected: Messrs. Carl Bartelt. Aug. Cloos, Henry R. Denison, Sydney R. Hartwell. Edw. E. Voss and Lindsay Webb.

There being no further business, the meeting was adjourned.

THURSDAY, NOV. 22, 1900.

The general meeting for November was held on the evening of the twenty-second, in the Museum lecture room, with President Teller in the chair and thirty persons present.

Chas. E. Brown reported on a meeting of the combined sections held on the eighth of the month.

Dr. Robinson was proposed for membership by Mr. Nehrling and elected a member of the society.

Dr. S. Graenicher next read a paper on the "Fertilization of Symphoricarpos and Lonicera," illustrating it by drawings showing the structure of the flowers and by specimens of all the insects he had found visiting them. Two species of Symphoricarpos were considered, *S. racemosus* and *S. occidentalis*. The first was visited principally by the smaller bees and the other also by a great many wasps.

Of the five species of Lonicera native to this locality, two, *L. ciliata* and *L. Tatarica*, are visited principally by the smaller bees, while the three remaining species, *L. dioica*, *L. oblongifolia* and *L. Sullivantii*, are bumble-bee flowers, but include also many of the smaller bees, a few flies and lepidoptera, as well as the humming bird among their visitors.

THURSDAY, DEC. 27, 1900.

This meeting was held in the usual place—the Museum lecture room—and was presided over by President Teller. The attendance was twenty-five.

C. E. Brown reported on a union section meeting and also on a meeting of the Archeology Section held earlier in the month.

Mr. Valentine Fernekes was proposed for membership by Mr. Nehrling and duly elected.

Ernest Bruncken then addressed the meeting on the physiography of Milwaukee County.

The speaker described the general features of the surface geology of the vicinity and drew attention to many problems that still awaited solution, such for instance as whether the terraces along the Menominee valley were identical in height with corresponding ones along the lake front. He drew attention also to the absence of large limestone boulders in this vicinity in contrast to their frequent occurrence farther west.

President Teller then read an instructive paper on fossil cephalopods, illustrating it with a number of specimens of local species from his own collection. He drew attention to a variation he had detected in the siphuncle of a cephalopod, *Orthoceras abnorme*

Hall, occurring in the Niagara formation at Racine, Wis., which perhaps justified its being considered as a new species or subspecies.

W. J. Bennetts read a paper on the winter birds of Lake Michigan, mentioning those species of the loons, grebes and gulls that were known to winter on the lake, and giving some attention to their winter habits.

The meeting was then adjourned.

THURSDAY, January 31, 1901.

The Wisconsin Natural History Society met this day in the lecture room of the Public Museum; thirty-three persons were present and President Teller occupied the chair.

Chas. E. Brown reported on section meetings held during the month, after which Mr. P. V. Lawson addressed the meeting on the antiquities occurring in the vicinity of Menasha, Wis.

The oldest relics of pre-historic man in that locality were considered by the speaker to be a class of chipped stone implements found by him on the shores of Lake Winnebago and at Green Bay.

They are of a black sandstone similar to the stone implements found in the Trenton gravels of New Jersey and probably belong to an age equally remote.

Next in order of antiquity are probably the stone cairns, and shell mounds, that occur at several places around lakes Winnebago and Winneconne.

Effigy mounds and oval mounds are exceedingly common in the locality considered. Three lizard mounds and a turtle mound have been preserved in the Elisha D. Smith Park, Menasha. Near Little Butte des Morts are two remarkable serpent mounds 1,210 and 1,580 feet long respectively, while near Stockbridge is what is probably the finest group of existing mounds in the world occupying 90 acres of primeval forest and representing many types.

The address was illustrated by numerous drawings and maps made from surveys taken by the lecturer, as well as by many archeological specimens and photographs.

Mr. John H. Tweedy was elected a member of the society and Dr. R. Menger, San Antonio, Texas, a corresponding member, after which the meeting was adjourned.

THURSDAY, February 28, 1901.

The Wisconsin Natural History Society held its general meeting this day in the Museum lecture room with the President in the chair and twenty-eight members and visitors present.

The report of the January meeting was read by the secretary and reports of two section meetings by Chas. E. Brown. At one of these—a meeting of the Archeology Section on the 21st—it had been proposed to extend the membership of the section so as to include archeologists from all parts of Wisconsin, and thus give the section the character of a state organization.

As a preliminary step in this direction Chas. E. Monroe gave notice that at the next meeting he would propose a change in the by-laws of the society so that hereafter the fee of non-resident members should be one dollar a year.

Mr. A. W. Slocum then read an instructive and interesting paper entitled, "The Development of Life Upon the Earth as Revealed by Paleontology."

After a brief historical account of the growth of the science, the different forms of fossils were mentioned and described, as well as illustrated by specimens and plaster of Paris models.

The geological eras were then considered in their order and at this point Mr. Slocum displayed a set of charts prepared by himself to illustrate the development of each of the classes of the animal and the vegetable kingdoms during geologic time. Each class was then taken up separately and its development clearly described, numerous specimens from the Public Museum collection of fossils being employed to illustrate the subject.

At this meeting Mr. Otto Grigrutsch was elected an ordinary member of the society.

THURSDAY, March 28, 1901.

President Teller presided over this meeting, at which twenty-eight persons were present. The minutes of the last meeting were read by the Secretary and Mr. C. E. Brown reported on two section meetings of much interest that had been held earlier in the month.

The lecture of the evening was to have been one on paleontology by Dr. Stuart Weller of Chicago, but the day previous word had been received from him that he would not be able to be present.

Three members of our society had therefore hastily prepared papers for the evening, which, if somewhat incomplete, were yet interesting on account of the variety of subjects treated.

The first paper by C. E. Brown was on the "Geographical Distribution of the Milwaukee Butterfly, *Anosia plexippus.*" The development and habits of this commonest of our lepidoptera were described and its range on the American continent shown to be from the shores of Alaska and Hudson Bay to the northern boundaries of Patagonia.

During the last half century it had spread westward to the South Sea Islands, the Malay Archipelago, and the Southern Asiatic coast, while to the east of our continent it had during the same period obtained a foothold in the Bermudas, the Azores and the western countries of Europe and Africa. At the end of another half century Mr. Brown predicted it would be doubtless common throughout most parts of the known world.

Mr. W. J. Bennetts then read some notes on the life history of the Virginia deer, *Cariacus Virginiana.*

The points chiefly considered were the development of its different coats and of the antlers, and its food and feeding habits at different seasons of the year.

Geo. A. West followed with a paper based upon a recent journey taken by him through the Republic of Nicaragua, Central America.

It dealt principally with the habits and superstitions of the natives of the East Coast. He also described at some length the peculiar habits of the leaf-carrying ants and also of the termites or white ants, to both of which he had paid considerable attention while in their habitat. Mr. West also exhibited a sheet used by the Indians and made from the inner bark of a native tree, and also some artistic examples of inlaid gold work done by one of the native women.

The meeting was then adjourned.

THURSDAY, April 25, 1901.

This being also the annual meeting of the society, much of the time was occupied by the reading of the reports of progress by the different officers.

C. E. Brown described what had been accomplished in the Biology sections and in the sections of Archeology and Numismatics during the past year, while the report of the treasurer, J. A. Brandon, showed that financially the society was in a satisfactory condition, there being a balance of $232.77 in the treasury. W. J. Bennetts also reported concerning his work as recording secretary and editor of the society's Bulletin.

Secretary's Annual Report for the Year from April 27, 1900, to April 25, 1901.

The progress made by the society during the past year and the work accomplished by it has been of a satisfactory nature.

Its membership now numbers 109, an increase of 22 over that of last year. Ten general meetings have been held, at which the average attendance was 27 and at which 15 papers were read by members of our society and others. These papers were principally of a popular nature, being intended for the general membership of the society and not for the specialist, and were as follows:

1.	"Dakota Burial Mounds"	Lee R. Whitney
2.	"Forestry"	Ernest Bruncken
3.	"Crustaceans of the Niagara Formation"	E. E. Teller
4.	"Sand Dunes at Ottawa Beach"	E. Bruncken
5.	"Local Ornithology"	J. A. Brandon
6.	"Earthworks of Waupaca County"	F. M. Benedict
7.	"Fertilization of Lonicera and Symphoricarpos	Dr. S. Graenicher
8.	"Physiography of Milwaukee County"	E. Bruncken
9.	"Fossil Cephalopods"	E. E. Teller
10.	"Winter Birds of Lake Michigan"	W. J. Bennetts
11.	"Antiquities of Menasha"	P. V. Lawson
12.	"Development of Life Upon the Earth as Revealed by Paleontology"	A. W. Slocum
13.	"Life History of the Virginia Deer"	W. J. Bennetts
14.	"Indian Tribes of Nicaragua"	G. A. West
15.	"Geographical Distribution of Anosia Plexippus"	C. E. Brown

One of the most important ways in which our society has been of use to its members has been through the interchange of ideas and observations at the section meetings.

Of these 19 have been held, 9 of the Archeology section, and 10 union meetings of the other sections. Many papers of a special character and containing the results of original investigation were presented at these meetings, a detailed account of which will be found in the report of their proceedings.

Two Bulletins, aggregating 130 pages, have been issued during the year. It has been our aim to publish nothing in our periodical but articles containing a large proportion of new facts or based upon original observations and research.

Naturally our society is expected to be the authority on all matters relating to the natural history of its own locality and to make it its special object to encourage and to carry on investigations in that field.

In this regard the work done has been encouraging and satisfactory. In the field of entomology we have published a list of the Lepidoptera of Milwaukee County by Messrs. Rauterberg and Demehl, a list of the Syrphidae by Dr. Graenicher, and studies on our solitary wasps by Geo. W. and Eliz. G. Peckham.

In the field of Botany Dr. S. Graenicher has worked up the local methods of fertilization of a great many of our native plants and we have published his papers on the fertilization and insect visitors of the different species of Lonicera and Symphoricarpos, and on *Trillium nivale, Erigenia bulbosa* and *Salix discolor*. Ernest Bruncken has also reported on the forest conditions of the vicinity and has worked up our species of Salix and Betula, while W. J. Bennetts has published a second supplement to W. M. Wheeler's "Flora of Milwaukee County."

In Ornithology we have published papers on our local Avifauna by John A. Brandon, P. H. Dernehl and W. J. Bennetts.

A paper by Geo. A. West on the "American Crocodile" was a valuable contribution to our knowledge of that little known animal.

Still, an enormous amount of work remains to be done in developing the knowledge of our local natural history. Wisconsin is almost an unworked field in this respect and less has been done in the way of exploring its flora and fauna than has been accomplished in much younger states lying to the west of us. Even in regard to the district lying immediately around our city it may be said that definite and accurate knowledge is still wanting in almost every line of natural history. The following subjects only may be mentioned regarding each of which almost no work has been done,—the mosses, lichens, fungi, fresh water algæ, the fishes, batrachians, crustaceans, reptiles and molluscs, without entering at all the immense field of entomology.

A recently published bibliograhpy of Indiana molluscs contains twelve pages and about 100 titles. A Wisconsin list would probably contain the titles of less than a dozen papers.

There are two matters which affect us in accomplishing work of this kind and which should receive careful consideration by our society in the near future. There should in the first place be a closer working relationship between our society and the Milwaukee Public Museum.

In order to arrive at an accurate knowledge of any of our local species it is necessary that large numbers of specimens be collected and preserved for future comparison and study. As an example it is well known that our common garter snake, *Eutaenia sirtaris,* is exceedingly variable, so that eleven or more sub-species are distinguished, and it is plainly only possible to arrive at the status of our own local species and varieties by the accumulation of a large collection of specimens. Some understanding and method of cooperation should clearly exist between our society and the Museum in matters of this kind.

Another matter. When our society was first organized one of its leading objects was clearly stated to be the formation of an efficient reference library of natural history works. For the past 40 years it has been receiving books and pamphlets of this character by purchase and exchange, and these are all at present stored in the offices of the Public Museum, and, besides being almost inaccessible, are uncatalogued and unindexed, and therefore of practically no use to the society.

There is urgent need for a well arranged and fairly complete Natural Science Library here in Milwaukee, and we should not let the matter rest until something permanent has been accomplished in this direction.

Still another matter has been in a manner thrust upon us during the past few months. The founders of our society plainly intended it as a state organization, and named it the *Wisconsin* Society, and distant parts of the State have at all times been represented on its membership roll, but the actual work of the society has practically always been confined to the vicinity of this City and to Milwaukee County.

Letters, however, have been received of late from science teachers, collectors and archeologists throughout the state, expressing a desire that our field of work be extended so that our society become in fact as in name a state organization. In fact steps have already been taken in our Archeology Section to extend its membership and its field of work in this way, but we think it wise to consider the matter well and weigh well all our resources before committing ourselves to any definite step of this kind. A large non-resident membership can only be successfully retained and the work of the organization carried on with such, by correspondence and publications, and this implies an immense amount of work for those who have it in charge. In other societies where such work is successfully conducted, those entrusted with it are generally persons having considerable leisure or those holding positions whose duties do not clash with the work they do for their society, such as government scientific officials or University professors.

There are, we believe, no men of leisure among our active members and probably none who could look after such work efficiently without considerable self-sacrifice, so that it behooves us not to hastily take any step in this matter until we are assured that what we do will be permanent and done well.

W. J. BENNETS, *Secretary.*

A Committee on Membership, consisting of Messrs. Habhagger, Cline, Stanhope and Bennetts, which had been nominated at a section meeting, was approved by the society upon a motion made by Mr. Harlowe.

A motion to the effect that the dues of non-resident members should henceforth be $1.00 per annum was made by Dr. Chas. Stanhope and unanimously carried.

The officers for the ensuing year were then elected as follows:
President—E. E. Teller.
Vice-President—Dr. S. Graenicher.
General Secretary—W. J. Bennetts.
Corresponding Secretary—Lee R. Whitney.
Treasurer—Geo. A. West.
Librarian—Adolf Biersach.

DIRECTORS OF SECTIONS.

Entomology—C. E. Brown.
Botany—E. Bruncken.
Archeology—W. H. Ellsworth.
Numismatics—W. F. Sandrock.
Geology—C. E. Monroe.
Ornithology—
Mineralogy—Louis Lotz.

The following were also elected to membership: Messrs. A. S. Mitchell, J. A. Sheridan, Thos. G. Laurenzen.

Mr. Adolf Biersach then read a paper entitled, "Snakes of the Genera Elaps and Osceola." Elaps is a genus of poisonous snakes consisting of about thirty species, whose character as to whether they are poisonous or non-poisonous was for many years a subject of debate among herpetologists. They are beautifully marked with red, black and yellow rings, and are mimicked in this particular by the king snakes of the genus Osceola, which on the contrary are all perfectly harmless.

It was shown by the speaker that the venomous genus could be distinguished from the non-venomous one by the fact that in Elaps the black rings are bordered by the yellow, while in Osceola the yellow rings are bordered by black.

The paper was illustrated by charts and drawings and by alcoholic specimens of *Elaps fulvius* and of *Osceola doliata coccinea.*

THURSDAY, May 30, 1901.

At this meeting Mr. A. Schroeder and Rev. J. W. Berg of St. Francis were elected members of the society, after which those present listened with much interest to a lecture by Prof. Stuart Weller of the University of Chicago entitled, "Modern Problems in Paleontology."

The lecturer described the methods employed, and some of the results achieved, by that branch of Paleontological Geology which dealt with faunal societies. It was shown how by its aid it was possible in a measure to restore the ancient geography of the earth at any geological period, and to determine the migrations of any of the fossil faunal types.

Prof. Weller then considered the Mississippi valley region of our continent; treating in detail each geologic period from the Silurian, up to and through the Carboniferous, showing how it was possible by a comparison of the fossil fauna of each era to map out the shallow seas and the land barriers then existing, and also to determine the order in which the changes took place, and from whence new fossil types were derived.

THURSDAY, June 27, 1901.

The general meeting of the Wisconsin Natural History Society for June was held in the usual place—the Museum lecture room—President Teller occupying the chair.

C. E. Brown read reports of section meetings held during the month, and he also stated that the botanists of the society had recently added many new plants and species of fungi to the Museum collections. Mr. William Riley was elected a member of the society. The election of Mr. Edw. E. Voss as director of the section of ornithology was approved. The attendance was 24.

Chas. E. Brown then read a paper entitled, "Types and Distribution of Grooved Stone Axes." It was shown how, according to the peculiarities of the handle-groove, they could be arranged into three main divisions: (1) Those having only a notch in each opposite side of the axe; (2) those with a groove extending around three sides; (3) those in which the groove completely encircled it. These could again be divided into several sub-classes according to the position and number of the grooves or the general shape or ornamentation of the axes themselves. Drawings were exhibited of specimens belonging to each class and the material, possible uses, and occurrence of these axes throughout the state discussed.

This paper was followed by a lecture by E. Bruncken on "Ecology," in which the general principles of this recently developed branch of botany were stated and explained, and applied to many of our local species of plants.

Mr. Herman Pereles of the Numismatic section then read an instructive paper entitled, "Jackson Tokens and Hard Times Money." He described the financial and political conditions that led to the issuing of these interesting series of coins, as well as many of the coins themselves in detail.

Dr. S. Graenicher next read a paper entitled, "Flowers Adapted to Carrion-Fly Visitors," which dealt principally with the fertilization of our three local species of Smilax, *S. herbacea, S. hispida* and *S. ecirrhata,* specimens of which and of their insect visitors were exhibited by the speaker.

A valuable collection of coins belonging to Mr. Altenberg was examined with much interest by those present. The expenditure connected with the holding of a State Archeological meeting was authorized by the society, after which the meeting was adjourned.

Thursday, September 26, 1901.

At this meeting, which was attended by 26 persons, President Teller brought the matter of the society's library to the attention of those present, stating that the documents relating to the transfer of the books to the Public Museum had been lost, and that while the Trustees of that institution had expressed their willingness to have the library properly catalogued and put in charge of a competent person, they did not see their way clear to do so while the ownership of the books remained in doubt.

The subject was discussed at some length by E. Bruncken, Dr. Stanhope and Chas. Doerflinger, after which a committee consisting of Messrs. Peckham, Monroe, West and Bennetts was appointed by the President to confer with the Museum Board and to look after the society's interest in this matter.

C. E. Brown then briefly reported concerning the section meetings that had been held since the last general meeting of June 27, after which the first paper of the evening was read by Chas. Doerflinger, whose subject was "The Prehistoric Exhibit at the Paris Exposition of 1900." He described especially the excellent reproductions of the rock pictures from the walls of caves that had recently been discovered in Southern France, those of the cave "Pair-non-Pair," near Bourg sur Gironde, being of unusual interest; and also drew attention to the value added to the exhibits by the numerous books of reference that accompanied them and that were accessible to all visitors. The adoption of some similar plan by our Public Museum was suggested in the paper.

Adolf Biersach followed with a paper on the habits of the common toad, which consisted largely in a defence of this useful little animal against the evil reputation that the superstition and ignorance of the people had conferred upon it.

At this meeting twenty persons were elected to membership as follows: E. R. Buckley, of Rolla, Missouri; Horace Beach, Sr., of Prairie du Chien; F. M. Caldwell, Princeton; W. P. Clark, of Milton; Matt Duane, Marshall; Wm. Finger, Milwaukee; Frank B. Fargo, Lake Mills; P. D. Griste, East Troy; Alphonse Gerend, St. Francis; W. W. Gilman, Boscobel; H. M. Jaycox, Lake Mills; Rudolf Kuehne, Sheboygan; Rev. J. G Laurer, Plain; I. H. Lyman, Kenosha; Frank Mueller, Princeton; G. F. Melcher, Woodland; R. L. Porter, Mukwonago; Chas. Slocum,

M. D., Defiance, Ohio; Geo. Schuette, Manitowoc; C. E. Wood, Mukwonago; H. A. Willard, Mazomanie.

Dr. Harlan J. Smith of the American Museum of Natural History was elected an honorary member.

THURSDAY, October 31, 1901.

The attendance was twenty-nine at this meeting, which was presided over by President Teller.

Chas. E. Brown, the secretary of sections, read the proceedings of a meeting of the Biology section and also of a meeting of the Archeology section, both of which had been held during the past month.

He also reported as to the work accomplished during two excursions made into Waukesha County on Sept. 30 and Oct. 21. Ten groups of undescribed mounds and several isolated mounds and earthworks had been surveyed and platted and considerable data collected in regard to the copper and stone implements peculiar to the localities.

The following were elected to membership: Miss H. B. Merrill and Messrs. S. C. Wadmond of Racine; Dr. H. B. Hinsdale of Ann Arbor, Mich.; P. V. Lawson of Menasha, S. D. Mitchell of Ripon, W. H. Canfield of Baraboo, Louis Falge of Reedsville and Herb. J. Johnson, O. L. Hollister and W. H. Vogel of Milwaukee.

The committee appointed to look into the matter of transferring the society's library to the Public Museum then reported through its Chairman, Dr. G. W. Peckham, as follows:

"Your committee to whom was referred the question of relations between the Natural History Society and the Public Museum, have the honor to report as follows:

First. They believe that in the interests of all concerned the library should be catalogued.

Second. That exchanges should be maintained and that where breaks occur in the series, steps should be taken to make good the missing volumes.

Third. That during certain days of each week the library should be open during reasonable hours during the evening. Under the present conditions the library is inaccessible except to persons so fortunate as to be able to command their own time.

Your committee further believe that if proper arrangements can be made with the Museum Trustees, that there can be no objection to the transfer of the title to the Museum. As an alternative proposition, and in the event of the Museum not caring to undertake any responsibility in caring for the library, the committee suggest that it be transferred to the Public Library of the city, where it would be catalogued and accessible to the public.

Respectfully submitted,

G. W. PECKHAM,
C. E. MONROE,
G. A. WEST,
E. E. TELLER,
W. J. BENNETTS.

Ernest Bruncken then moved that the committee be given full power to make an agreement with the Museum or the Library on the basis of these principles, which motion was seconded and carried.

The lecture of the evening was by Dr. Peckham and was entitled "Some Points in Geographical Distribution."

The speaker illustrated by numerous examples the fact the world could be divided into many life or faunal areas, and that the original explanations given of these, such as, for example, that they depended upon the amount of heat, or that certain resemblances were due to a former land connection, failed to interpret the facts as they were now known. The modern view is that distribution was brought about by the same natural forces that are to-day in operation, and that those changes that are at work in Geology operate also in Biology.

The West India Islands have a warm and tropical climate, but are remarkably destitute of animal life, both of species and individuals, except in the case of introduced species. Geology shows that they have been several times raised and submerged and as many times has life been destroyed and repopulation taken place, doubtless by drift species from the nearest mainland.

This theory is supported by the fact that the fauna of Cuba is related to that of North America, while that of Jamaica resembles more nearly that of South America.

Prof. E. C. Case, after the lecture, discussed these latter points, showing that any extensive migration from the adjacent continent would be largely prevented by the prevailing winds and currents from the eastward, and that in the case of amphibia it would be prevented by the fact that salt is fatal to most of the species.

Mr. W. H. Ellsworth displayed a grooved stone axe from Dakota which was of unusual shape, being almost entirely spherical.

The meeting was then adjourned.

WM. J. BENNETTS, Recording Secretary.

Studies in Plant Distribution.

By ERNEST BRUNCKEN.

1. On the Succession of Forest Types in the Vicinity of Milwaukee.

In a former paper (Bull. Wis. Nat. History Society, I, page 178) the forest conditions in the vicinity of Milwaukee were considered principally from the economic standpoint. The following pages are an attempt to treat some of the peculiarities of the forests of the same region from the standpoint of ecological distribution.

The forests of the Milwaukee region are almost exclusively of the deciduous, mesophytic type, xerophilous associations being now represented only by the meager remnants of tamarack swamps still lingering here and there. But there is evidence of the former prevalence of xerophytic, principally coniferous associations; and within the mesophytic association a number of distinct groups of more or less pronounced mesophily can be clearly distinguished. Between these sub-associations a vigorous contest is carried on, so that there are numerous transition stages.

The mesophytic association may be conveniently divided into three sub-associations, according to the degree of mesophily exhibited in the species of which they are most prevalently composed. These sub-associations are:

1. The hemi-xerophytic sub-association. Its characteristic species are various oaks, particularly the white and burr oaks; the shell-bark hickory and the black cherry.
2. The mesophytic sub-association, with the basswood, the hard maple, and in a part of the region the beech (1) as its most characteristic members.
3. The hemi-hydrophytic sub-association, in which various elms, black ash and cotton wood are leading species.

The first of these sub-associations is probably the most widely spread in the region. It is characterized by the great light demand of the trees composing it. In addition to the species mentioned, we find in this sub-association *Quercus rubra* and *tinctoria, Ostrya Virginica, Populus tremuloides* and *grandidentata Hicoria ovata* and *glabra*. The underbrush shows, in addition to the young seedlings and saplings of the trees, several shrubs with xerophytic characters, such as various species of *Ribes*, hazelnut and witch hazel. In places there are thickets of *Rubus,* and *Xanthoxylum* is not uncommon. The herbaceous flora is rich, both in species and individuals, and golden rod, sunflower and asters find here their favorite habitat.

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(1) On the peculiarities of distribution of the beech, see Wis. N. H. S. Bulletin, I, page 33.

The second sub-association is characterized by the great shade tolerance of some of its members, and probably as a consequence of the deep shade prevailing in its midst, by the thick layer of humus found on the floor. In addition to the hard maple and basswood, there belong to this association the butternut, the black walnut (now rare), and the white ash. The underbrush is apt to be less dense than the preceding class, and often confined to the places where the canopy has been broken. It is composed largely of the same shrubs that are found in the preceding sub-association, except that the hazelnut is not likely to be found, and that *Sambucus nigra* may be added. The herbaceous vegetation is apt to be scanty, especially in summer, when the crowns are fully leaved. Often the dry leaves monopolize the floor almost entirely. Among the herbs most often accompanying this association should be mentioned *Podophyllum peltatum, Viola scabriuscula, Trillium grandiflorum,* and two species of *Erythronium.*

This sub-association rarely occupies large areas; it is usually found in the form of islands among the surrounding sea of the hemi-xerophytes. Often it inhabits damp ravines, where the accumulation of humus is assisted by washing from the sides. As the two associations are still in the fighting stage, neither is very firmly established in any particular locality. Consequently it is by no means uncommon to find individuals belonging to the one sub-association scattered among the other. But in those places where there has been no modification by human interference such as will be described below, this difference is quite noticeable: The hemi-xerophytic trees scattered among the maple-basswood sub-association are usually old, often veterans in a state of evident decay; on the other hand, where maples, basswood and their associates are found among the oaks and hickories, they are more often young trees. This phenomenon will throw considerable light on the history of these forests, and should be borne in mind for the discussion which will follow below.

The hemi-hydrophytic sub-association may again be divided into a double group, according as it is found in the swampy depressions of the uplands or in the river bottoms. The difference is not so much in the species as in the way in which they are associated. In the upland swamps(2) *Ulmus Americana* and *Frax-*

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(2) These swamps are usually fairly well drained, dry after about the first of July, and very distinct from the tamarack swamps. Their center is usually in part open water, in part occupied by the swamp loving shrubs mentioned in the text.

inus nigra are by far the most numerous, silver and red maple (3) are interspersed very sparingly, *Ulmus fulva* a little more frequently, and *Quercus bicolor* is common. The underbrush consists of many species of *Salix, Cornus, Viburnum,* etc. Creepers, such as *Ampelopsis, Lonicera, Smilax* are characteristic of this as well as the second group of this sub-association, while they are practically unknown in the other forest associations (with the exception of *Evonymus*). The soil is probably sour in not a few cases, as would be indicated by the rich development of swamp-loving mosses, *Cyperaceae,* etc. Phanerogamic herbs growing under the shade of the trees mostly have some xerophytic characters (*Viola blanda* and *Labradorica, Majanthemum Canadense,* etc.), in sharp contrast to the hydrophytic flora towards the middle of the swamps.

The second group of the hemi-hydrophytic sub-association, the bottom woods, has been more disastrously affected by human activity than any other portion of the forests of the region, except the tamarack association. There can be little doubt that previous to the settlement of the country this group occupied the entire valleys of the Milwaukee, Menomonee and Kinnickinnic Rivers with the exception of the sedge and wild rice marshes at their mouth, and perhaps isolated patches of tamarack swamp and hydrophytic shrubbery. To-day a few small remnants is all that is left of the bottom forest, such as the grove near the junction of Honey Creek and the Menomonee. On the pastures which now form the largest part of the river valleys, there are scattered a good many groups and individual trees, some of them in full vigor, others in various stages of decay, stag-headed and hollow-boled. From these remnants, however, it is possible to draw a mental picture of what these woods must have looked like when they were in their pristine glory. Three species of elm (*Ulmus Americana, fulva* and *racemosa*) seem to have furnished the most numerous host; associated with them were *Celtis occidentalis,* which now remains only in comparatively few individuals, the largest group known to the writer growing near the County Insane Asylum, *Quercus bicolor, Acer dasycarpum, Acer Negundo, Populus deltoides, Fraxinus nigra, Salix amygdaloides.* The trees in this group seem to have grown to very great dimensions, if one may judge from the giants which still remain. Creepers of the species mentioned above were abundant. It is probable that the forest was interrupted by considerable areas covered with shrubs. Such thickets have again come up in many places since the original growth was destroyed.

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(3) Young red maple trees are occasionally found among young growths of hard maple, away from the proximity of swamps.

They cannot properly be classed with forest associations, but must be considered as a distinct formation, and will not be considered here in detail. The remnants of the bottom wood group are in evident course of extinction. The old trees are gradually dying or being removed by the axe. Windfalls are exceedingly common in the thinned stands of elm. The young trees that are coming up are as apt to be hard maples and other trees from the mesophytic uplands as the progeny of the original occupants.

Having thus briefly described the three mesophytic forest sub-associations of the region, the question arises as to their history. The hemi-hydrophytic sub-association is evidently conditioned directly by the physiography of the country. But the other two seem to be far more directly the result of the struggle for life among species.

To understand the mutual relations of these two types of forest it is necessary to throw a glance at a somewhat wider region than that under immediate consideration. The vegetation map of Eastern Wisconsin, accompanying the first Geological Survey of the State, shows that there is a broad belt to the west of Milwaukee County, which is there denominated the Oak Group. To the east of this is a strip classified as the Oak and Maple Group, and still farther east comes the Maple and Beech Group. A visit to the forest anywhere within the Oak Group will show that various species of oak are almost the only trees found there. Their only associates are the hickories, only in some places the black cherry is found. These are precisely the species which have been mentioned as the characteristic ones of the hemi-xerophytic sub-association. Perhaps it is possible to divide even this sub-association into several groups of more or less highly developed xerophily. At all events, the white and burr oak seem to have more pronounced xerophytic characters than the red and black oaks, and it is well known that groves of stunted burr oaks are not uncommon as far West as South Dakota, where conditions are decidedly xerophytic.

A closer study of the oak forests will show that here and there, usually in a deep ravine or in the neighborhood of a lake or water course, there are a few individuals of basswood. The vicinity of such trees is usually distinguished also by the occurrence of strongly mesophytic herbs, such as *Podophyllum peltatum,* which are uncommon in the purely oak forests. Sometimes one will notice that the basswood and its minor companions grow exclusively on the southerly side of a ravine, while they are entirely absent on the northerly side. One remembers that these locations receive less sunlight than the northerly slopes. Their greater shade and consequently damp and cool condition retards the oxydization of the vegetable mould, and in such places the humus is deeper and richer than is usual in the oak woods, with their insufficient shade. As one travels eastward, the maple makes its appearance, at first sparingly and confined to such localities as have just been described. By the time one is fairly within the territory of the Oak and Maple Group of the map, maples and basswood and their associated trees mentioned above occur with growing frequency on the ordinary uplands a well as in ravines and coves. Going still farther east, and coming within two or three miles of Lake Michigan, one begins to find the beech, the tree which of all trees of the region throws the densest shade and grows in the places with the deepest and richest humus.

This geographical arrangement suggests that its cause is the amount of humus required for the various species. The oaks and their associates demand the least of it. The basswood comes next, while maples and beeches demand the richest soil. It might be supposed that the distribution of these trees is determined by the mineralogical character of the soil on which they grow. But this is negatived by a comparison of the vegetation map and the soil map found in the Geological Survey atlas. From this it appears that maples and beeches are found indiscriminately on "heavy marly clay," "lighter marly clay," "calcareous sand" and "red clay"; while the oak forests, although mostly on "lighter marly clay," are by no means confined to that soil formation.

Although sufficient sunshine reaches the forest floor under an oak canopy to cause comparatively rapid oxydization of the vegetable mould, that process is not rapid enough to prevent the slow accumulation of humus even in an oak forest. It is consequently a mere question of time until there will be sufficient humus in all the oak woods to satisfy even the hard maple. But as soon as the maple has gained a foothold it prevents by its dense shade the growth of oak seedlings, while its own seedlings, with their remarkable shade tolerance, can flourish well enough. At the same time it gives a great impetus to the further accumulation of humus. In the course of ages, therefore, with no new factor entering into the process, the maple and its associates would supplant the oak and its accompanying species everywhere in this region. The maple-basswood-beech sub-association is consequently the culmination type of forest in this locality. It is safe to assume that at one time Milwaukee County was covered by almost pure oak forests (with the qualification to be discussed forthwith), such as are now struggling with the prairie formation in the Rock River valley and the country immediately to the east of that.

The further question presents itself: Why are the maples, basswood and beeches so much better developed in the neighborhood of Lake Michigan than they are twenty or thirty miles inland? The hypothetical answer which suggests itself is that the nearness of so large a body of water has a modifying influence on the hygricity and temperature relations of the climate, by which the accumulation of humus in the oak forests is favored by retarding of oxydization. The correctness of this hypothesis can be determined by nothing except numerous and long-continued meteorological observations in various localities. Such data are not in existence, and there is no prospect that the gathering of them will be commenced in the near future.

The culmination type of forest has not been reached in this vicinity anywhere except in small, isolated, specially favored areas. By far the greater part of the territory is in a transition stage, presenting neither the purely mesophytic nor the hemi-xerophytic character. On the whole it is probably easier to find areas decidedly of the latter kind than of the former. It is apparent, then, that the course of development from the oak forest through the various transition stages to the basswood-maple-beech, or perhaps eventually to the pure maple forest, has not yet become completed.

Perhaps it would be more correct to say: Had not been completed when the settlement of the region brought in a new factor of the greatest modifying power. Not only was the greater part of the territory wholly deprived of its forest cover by human hands, but the remaining tracts of forest were cut up into small parcels, of sizes ranging up to about a hundred acres, but usually much smaller. This reduction alone would probably be sufficient, by allowing the better access of wind to the forest floor, to make the conditions more xerophytic, especially as the edges of the tracts are rarely protected against the drying influence of the wind by a mantle of shrubs. But in addition a great many trees have been culled from the forest everywhere, so that frequently the crown cover is very much broken and the sunshine has full access. This of course increases the rate of oxydization of the humus and prevents its accumulation to a great degree. The floor in such places is often covered with a dense growth of grasses. All these factors tend to reverse the natural progress towards the purely mesophytic sub-association. It is quite noticeable that taking the region as a whole the oaks are on the increase. In many places, especially where there is much grass, oaks are practically the only young trees to be found.

However, there are isolated tracts here and there, on which, through accident probably more often than design, the maple has been favored. This has occurred where the culling has been moderate, so that the shade on the floor remained too dense to allow the growth of the intolerant oaks. Thus there is a considerable tract in the town of Wauwatosa, which is now an almost pure maple wood with the young trees ranging in age from the last year's seedling up to good-sized poles. The few standards remaining are in about equal numbers oaks and maples, but oak seedlings are entirely absent. The floor is almost bare of vegetation and the humus deep and rich. Similar places are found scattered in many parts of the country.

It was stated in the beginning of this article that there was evidence of this region having been clothed at one time with a xerophytic forest, mostly composed of conifers. This proposition remains to be discussed.

A glance at the vegetation map shows that to the north of Milwaukee County the Oak and Oak and Maple Groups are replaced by two quite dissimilar types of forest. In one of these the white pine is prevalent; this group stretches along the Lake Shore in a strip that gradually narrows as it comes South. The other type is characterized by the prevalence of hard maple, yellow birch and hemlock, and the almost complete absence of oak. This is the association which covers such large areas in the central part of Northern Wisconsin (4). Of both these associations relicts are not infrequently found in the neighborhood of Milwaukee, thus indicating that they must once have been represented in this region.

The white pine association has for its most characteristic companion tree the paper birch. This tree is still common in a very narrow strip along the shore of Lake Michigan. The white pine itself formerly occurred in the same narrow strip, but the last large specimens seem to have disappeared a few years ago. It is said that a few very small individuals are still growing in a ravine near Fox Point. Going south, from Milwaukee, the white pine re-occurs on sandy beaches and on the dunes near Chicago. The paper birch is very well developed in several places along the Lake Shore, to the South, conspicuously so on the broad and swampy land flat north of Waukegan, Ills. Small species usually accompanying this association, such as *Pteris aquilina,* are found sparingly in the paper birch strip, although they are entirely absent everywhere else in our territory. The conclusion can hardly be avoided that the white pine areas of the North and the Southern end of the Lake were formerly connected by a strip along the Lake Shore (5).

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(4) See Roth, Forest Conditions of Northern Wisconsin.

The signs that the maple-yellow birch-hemlock association was ever present in this neighborhood are not quite so convincing as those of the white pine association. The only direct evidence discovered so far is the occurrence of *Betula lutea* in this neighborhood (see Bull. Wis. Natural History Soc., I, page 31). But there is good theoretical ground for assuming such a stage in the history of our forest. For in the regions to the Northward, the white pine association is normally succeeded by this or similar associations, the development proceeding from the interior to the shore (6).

The white pine association is of course typically xerophytic; the only other xerophytic forests found in our region are the tamarack swamps, which were formerly quite extensive but have now almost disappeared, principally through the direct activity of man.

The result of this inquiry into the history of the forests of the Milwaukee region is the following:

The earliest forests of which we can find any trace belongs to the xerophytic white pine association. It was probably succeeded more or less completely by a forest similar to the hardwood forests of Central Northern Wisconsin, in which maples, yellow birches, and perhaps hemlock played a leading part. Whether this group ever occupied the whole area not reserved to the white pine association, or whether in some places the pines were directly supplanted by the oaks that must have invaded the territory from the Southwest, it is now impossible to tell. Nor is there any clear evidence to show what caused the birches to disappear. It is certain that the oaks successfully conquered the whole territory excepting the swamp lands and river bottoms, which developed distinct associations. What gave the oaks their temporary advantage over the maples and birches we do not know. After a while the maples, but not the birches, began to reconquer the lost ground, and the forests progressed towards a basswood-maple-beech culmination type, when the interference of man gave a renewed advantage to the oaks.

II. Contributions to the Ecology of the Genus Viola.

The fact that a large number of plants growing in undrained swamps have numerous xerophytic characters is well known.

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(5) The immediate shore of Lake Michigan, i. e. the beach, terraces, clay banks and ravines, have so distinct and peculiar a flora that they deserve separate treatment, which must be reserved to a later time.

(6) See H. N. Whitford, Genetic Development of the Forests of Northern Michigan, Botanical Gazette, vol. 31; May, 1901.

Various suggestions have been made to explain this phenomenon, which is so surprising when first encountered (7), but hitherto these suggestions have not ripened into more than plausible hypotheses. The following observations may furnish some material towards an ultimate solution of the problem:

The genus *Viola* is represented by seven species in the near neighborhood of Milwaukee, and by at least four others in other parts of Eastern Wisconsin. These species form an illustrative series in which xerophytic characters increase as one departs from those growing in typically mesophytic places to either those species inhabiting dry hillsides or wet and boggy situations. The species forming the mesophytic center is *V. scabriuscula.* It has hardly anything suggestive of a protection against excessive transpiration, with its broad leaves, juicy stems, light green color and almost complete absence of pubescence. This species flourishes in the shadiest portions of our mesophytic forests, under the hard maples and beeches, where the humus is deepest and yet the drainage sufficient to prevent the formation of deleterious acids. Very similar to this species both in habit and habitat is *V. Canadensis,* which does not occur in Milwaukee County but is fairly common farther North. The next species in regard to slight development of xerophytic characters is *V. pubescens.* The name of this species is by no means suggestive of its general appearance, for while one can find individuals with a fairly conspicuous coat of hair, there are others almost as naked as *V. scabriuscula.* The seed pod is an exception, for this organ is invariably covered with a very close coat of hair. This species is also found principally in the mesophytic forest, but it is not so closely confined to the beech and maple groups as *scabriuscula.* It is quite satisfied with the ordinary type, where oak, hickory, cherry and other trees compete with the maple, where the shade is less dense and the humus does not reach the same thickness and richness. *Viola obliqua* and the rather rare *V. ovata* come next. They are not absent from the forests where *V. pubescens* has its favorite stations, but far more characteristic of thickets of shrubs and saplings, where there is still a reasonable amount of humus. They are also found in the vigorous grass of meadows, and in the willow brush along the rivers. In at least one place I have found *Viola obliqua* growing copiously in a small sedge marsh. Both of these species have a few xerophytic characters, the most conspicuous of which is the rolling in of the leaf edges. (This also occurs sometimes in *V. pubescens*). By this the stomata of the upper leaf surface are protected from the wind.

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(7) See Warming, Oekologische Pflanzen-Geographie, German ed., page 69.

All the species mentioned so far one would not think of classing otherwise than as mesophytes. The next one, however, is quite distinctly xerophytic, although not extremely so. This is *V. sororia,* a species very similar to *V. obliqua,* but distinguished by the pronounced hirsuteness of the green parts. It is perhaps the commonest species in this neighborhood, and invarably occupies dry localities, such as sunny hillsides or the hawthorn scrub lands. Hardly ever does one find this and its cousin, *V. obliqua,* intermingling, although it is common to see the latter flourish at the foot of a hill, where the ground is fairly moist and the insolation moderate, while the adjacent slope, dry and exposed to hot sunlight, shows numerous plants of *V. sororia.* Stations similar to those occupied by this species are pre-empted by *V. pedata* in many places a little farther west, for instance on deforested slopes of the Kettle Range. The division of the leaves in this species seem to be a xerophytic adaptation, serving a similar purpose as the hirsuteness of *V. sororia.*

In some places, *e. g.* near the Lake Shore in section 36, Town of Oak Creek, the last named species shares its dry habitat with *Viola Labradorica.* But more often that species is found in the damp, almost swampy places in the forest, where elm, black ash and red maple indicate the great moisture content of the soil. Here the ground is often largely occupied by mosses, and among these the low, much-branching plants, with their tangle of thin, superficial roots and little pale flowers are found. The habit of this species forms a striking contrast to that of its mesophytic cousins, like *V. Scabriuscula* or *Canadensis.* Where it grows copiously, it forms carpets on the ground, and might almost be called cespitose. In its neighborhood in such damp, mossy localities one is quite apt to find also the smallest of our violets, *V. blanda.* Both of these species are distinguished for their small size. But the peculiarity of *V. Labradorica* which is most interesting in the present connection is that it seems to flourish equally well in decidedly dry and pronouncedly wet situations. *V. Labradorica* is closely allied to the European *V. canina,* in fact so closely that some taxonomists will give it only varietal rank. (*V. canina Muehlenbergii.*) Now the European form is found in very dry localities, such as gravel slopes where the dominant vegetation consists of xerophilous grasses like *Festuca ovina,* or among the heather. There must be something in common between the two apparently so very different stations in which *Viola Labradorica* is found, and that common quality must be something which favors xerophytic adaptations. For the low growth and semi-cespitose habit of this species is a fairly pronounced indication of xerophily.

It seems to me that the similarity consists in this: In the dry places, especially the gravelly, strongly insolated slopes, there is very little humus. What little there may be found is sometimes sour or "raw"; in fact the dense tangle which roots often form in such localities is well known for its tendency to produce sourness by hindering aeration. Similar sour humus is found in the wet, swampy forests. Sour humus makes it more difficult for the roots to absorb moisture, and consequently it becomes necessary for the plant to reduce the transpiration. The lack of oxygen and assimilable forms of nitrogen in such soils still further induces a weakening of physiological activity. Now the series of *Viola* species outlined above shows clearly that the number and importance of xerophilous adaptations increases in inverse proportion of the presence of fresh, well-aerated humus, from the maple-beech forests to the dry hillsides on the one hand and the boggy elm and black ash forests on the other. Does not this circumstance indicate that there must be some causal connection between the quality of the humus and the occurrence of xerophytic characters?

It will be noticed, however, that there is a marked difference in the kind of adaptation between the dry and wet xerophytic stations. In the dry localities the most conspicuous feature is hairiness and next to it the rolling in of the leaf edge. In the swamp, what one notices most of all is the reduction in size, both of the plant as a whole and the proportion of the various organs of assimilation and transpiration. *V. Labradorica* is one of the smallest of our violets, both as regards length of stems and breadth of leaves. (The flowers are also smaller than in most other species.) *V. blanda* is smaller still. European species in similar stations, like *V. palustris*, which grows in sphagnum bogs, and *V. biflora,* which is found in gulches and on rocks where the water is constantly dripping, are also among the smallest of violets. On the other hand, *V. sororia* does not appear a bit less vigorous and full-sized than its cousin *V. obliqua,* though the latter has far better advantages as regards humus.

It will suggest itself therefore that the plants growing in sour humus have a tendency towards reduction in size, and a glance at other species than those of the genus *Viola* confirms this impression. Although hairiness is not entirely absent in bog plants, it is uncommon (8); but nearly all such species are distinguished by small leaves. This is true of many *Ericaceae*, and of conifers, such as tamarack and spruce. In very bad localities, such as sphagnum bogs, the spruce which occasionally grow there suffer an individual dwarfing, so that such a tree, although but a few feet high, may be a hundred years old.

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(8) See Warming, Op. cit., page 174.

The results which appear to flow from the above observations are the following:

1. The occurrence of more or less xerophytic species of *Viola* in a given locality depends on the amount and quality of humus in the soil. 2. Scantiness of humus favors specific adaptations for reducing transpiration, but does not diminish the vigor of growth; sourness of the humus tends to produce dwarfishness both of the whole plant and its separate parts.

The case of *Viola obliqua* growing in a sedge marsh, as mentioned above, does not necessarily militate against the second conclusion. It is by no means uncommon to find colonies of a species in a station not at all adapted to its growth. But such colonies are apt to be transitory; the numbers and individual vigor of the members is likely to diminish with each generation, until they disappear. I am unable to state how long *V. obliqua* has been in the marsh in question, but it will be interesting to watch its future history. It is probable that it will gradually disappear, unless the marsh should dry up and its soil become less sour; or unless the invaders should develop a variation which would adapt it to the new conditions.

Flowers Adapted to Flesh-Flies.

By DR. S. GRAENICHER.

The flies which are to be considered in the present paper, in regard to their relations to certain flowers, agree more or less in their food-habits, and are members of the families Sarcophagidae, Muscidae and of a few other closely allied families. They are the scavengers among the flies, feeding either in their larval state or as perfect insects on decaying organic matter, but also resorting to flowers in search of honey and pollen. Some of these are popularly known as flesh-flies, carrion-flies, dung-flies, etc., according to the nature of the substances to which they usually pay their attention. They are guided to these substances by the putrid odor emanating therefrom, and for this reason we might expect any flower, producing a similar odor, to be especially attractive to them. Delpino has given an account of two species of Stapelia from the Cape of Good Hope, plants belonging to the family Asclepiadaceae, the flowers of which are carrion-scented and are visited by flesh-flies (sapromyiophilous). The Papaw, *Asimina triloba,* Dunal, a plant well known in this country, especially throughout the Southern States, on account of its edible fruit, produces dark purple flowers which are also sapromyiophilous. From Southern Illinois Robertson (1) has reported the visits of 9 flies to these flowers, seven of which are flesh-flies, or other flies of similar food-habits. At Firenze, in Italy, Delpino observed seven species of flies on the flowers of cultivated specimens of the Papaw.

In our surroundings there occur three species of Smilax (family Smilaceae), two of which, *S. ecirrhata* and *S. herbacea,* produce flowers of a disagreeable odor, as the name carrion-flower, given to one of them, implies, while the flowers of the third species, *S. hispida,* are sweet-scented. In color and structure of the flowers all three species agree, but they differ essentially in the odor of the flowers. For this reason they furnish a suitable material for determining the effect of the putrid odor on the various types of flower-visiting insects.

Besides these two sapromyiophilous species of Smilax, a third plant is represented in our flora with flowers of an offensive odor, and of a dark purple color besides. This is *Euonymus atropurpureus,* the Waahoo, a member of the family Celastraceae, and it will be considered in the course of this paper, with the same points in view as in the case of the Smilax-species.

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(1) Chas. Robertson, Flowers and Insects, Trans. Acad. Sc. St. Louis, Vol. VII, No. 6, pp. 154-5.

The flowers of the latter have a greenish color. In a paper on the pollination of the greenish-yellow flowers of plants belonging to the genera Caulophyllum, Ptelea, Rhamnus, Rhus and Sassafras, Robertson (2) reviews the opinions held by various authors on the effect of the greenish color of the flowers on the insect-visitors. According to Delpino and Herm. Mueller, such flowers are very attractive to the larger flies (macromyiophilous), but the observations of Robertson show a distinct predominance of the flies in one species only, in *Sassafras officinale,* Nees, while in the remaining species (with the exception of *Caulophyllum thalictroides* (L.) Michx.), the lower bees, Andrenidae are the leading visitors. Of the dark colored flowers, such as are present in our Waahoo, (*Euonymus atropurpureus*) Delpino and Herm. Mueller express the view that they are visited mostly by flesh-flies (sapromyiophilous). As will be shown later on, the observations made on the Waahoo do not support this view.

SMILAX L.

The plants are dioecious, and produce simple flowers, which, in our own three species, present a very slight variation in structure, size and color. The staminate, as also the pistillate flowers, are gathered in axillary umbels and have a greenish-yellow color. In the staminate flowers the perianth-segments and stamens are present to the number of six, rarely of eight, and honey is secreted around the base of the filaments, as also along the inner surface of the perianth-segments. The pistillate flower has the same number of perianth-segments as the staminate, and contains an egg-shaped ovary, crowned with a three- or rarely a four-parted stigma. In addition to these parts it has abortive stamens, consisting of small filaments without anthers, which are appressed to the ovary, and never spread, as they do in the staminate flowers. The secretion of honey around the base of the ovary, and on the inner surface of the perianth-segments, is about the same as in the staminate flowers. The abundant whitish pollen of the staminate flowers renders the latter more conspicuous than the pistillate flowers, in which all the parts are of a greenish color.

The characters mentioned above are those common to all three of our species.

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(2) Chas. Robertson, Flowers and Insects, XVII, Bot. Gaz., Vol. XXII (1896), pp. 154-165.

SMILAX ECIRRHATA, S. WATS. UPRIGHT SMILAX.

This is our earliest Smilax, blooming from May 19th to June 12th. The stems grow upright, varying in height between six and nine dm., and producing long-stalked axillary umbels, with numerous erect flowers of one cm. diameter. In the older flowers the lanceolate perianth-segments are somewhat reflexed. The staminate and pistillate flowers of plants, growing under the same conditions, open at about the same time. The stamens are strongly divergent, and all the anthers of the same flower shed their pollen synchronously. In the pistillate flower the abortive stamens are represented by four to six thin, poorly developed filaments, while the stigmatic lobes are comparatively large, and covered with numerous papillae. Nectar is secreted abundantly by both kinds of flowers, although in fine weather the flowers are mostly found with hardly any nectar, the supply having been exhausted by the very numerous insect-visitors. The putrid odor of the flowers, staminate as well as pistillate, is very distinct and may be likened to the smell of decomposing cheese.

Smilax ecirrhata presents a case of trioecism. Besides plants bearing either staminate or pistillate flowers, specimens are found with perfect (hermaphrodite) flowers exclusively. Such plants have appeared regularly for the last three seasons in a piece of woodland near the northern limits of Milwaukee, in Mineral Spring park. These perfect flowers are homogamous. Their anthers and ovaries are not as well developed, as is the case in the staminate and pistillate flowers, but they nevertheless furnish normal pollen and produce fruit. Trioecism has not yet been observed in any of our other species of Smilax.

On different days within the last four years, the following visitors have been taken on the flowers of *Smilax ecirrhata:*

A. Hymenoptera.

Andrenidae: (1) Andrena, sp. ♀, c. p.;* (2) *Augochlora viridula, Sm.* ♀, s. and c. p.; (3) *Halictus fasciatus, Nyl.,* ♀ c. p.; (4) *H. fulvipes, Sm.* ♀, s. and c. p.

B. Diptera.

Tipulidae: (5) *Tipula graphica, Doane;* Syrphidae: (6) *Mesogramma geminata, Say;* Tachinidae: (7) *Gonia capitata, DeG.;* Muscidae: (8) *Hemichlora sp.;* (9) *Pollenia rudis, Fabr.;* (10) *Calliphora erythrocephala, Meig.;* (11) *C. vomitoria, L.;* (12) *Phormia regina, Meig.;* (13) *P. terrae-novae, Desv.;* (14) *Lucilia sylvarum, Meig.;* (15) *L. caesar, L.;* (16) *L.*

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* ☿ Worker; ♂ Male; ♀ Female; s Sucking; c p Collecting Pollen; f p Feeding on Pollen.

sericata, Meig.; (17) *L. splendida, Meig.;* (18) *Pseudopyrellia cornicina, Fabr.;* (19) *Morellia micans, Meig.;* (20) *Myospila meditabunda, Fabr.;* (21) *Clinopera sp.;* Sarcophagidae: (22) *Helicobia helicis, Town.;* (23-28) *Helicobia spp.;* (29) *Sarcophaga sarraceniae, Riley;* (30-32) *Sarcophaga spp.;* Anthomyidae: (33) *Drymeia sp.;* (34) *Ophyra sp.;* (35) *Phorbia fusciceps, Zett.;* (36-37) *Phorbia spp.;* Scatomyzidae: (38) *Scatophaga squalida, Meig.;* Ortalidae: (39) *Rivellia flavimana, Loew;* (40) *Chaetopsis aenea, Wied.;* Sepsidae: (41) *Sepsis violacea, Meig.;* (42) *Piophila casei, L.;* Oscinidae: (43) *Chlorops grata, Loew;* (44) *C. assimilis, Macq.;* Borboridae: (45) *Borborus equinus, Fall.;*—all s. or f. p.

C. Coleoptera.

Elateridae: (46) *Cardiophorus obscurus, Lec.;* Malachiidae: (47) *Malachius montanus, Lec.;* (48) *M. thevenetii, Horn;* Cerambycidae: (49) *Leptura lineola, Say;* (50) *Acmaeops bivittata, Say;* Chrysomelidae: (51) *Orsodachna atra, Ahr.;* Anthicidae: (52) *Corphyra lugubris, Say*—all s.

D. Hemiptera.

Pentatomidae: (53) *Corimelaena lateralis, Fabr.* s.

Before drawing any conclusions from this list of visitors, it may seem advisable to first consider our other species of Smilax and then compare the results obtained.

SMILAX HERBACEA, L. CARRION-FLOWER.

The flowering season of this species is a continuation of that of the preceding species and extends from June 10th to July 13th. As a rule the plants attain a greater size than those of S. ecirrhata, growing to a height of 2 m. and sending off a number of branches. Besides this is a climbing species, another feature separating it from *S. ecirrhata.* As regards the flowers, they agree so closely with those of the preceding species, that a description of them may seem superfluous. Occasionally an umbel contains as many as eighty flowers, in which case it has a globular form.

Although disagreeable, the odor of these flowers is decidedly less putrid than that of the flowers of *S. ecirrhata;* it is a peculiar odor, reminding somewhat of rotten fruit.

The following list of visitors has been obtained through repeated observations during the last four seasons:

A. Hymenoptera.

Andrenidae: (1) *Andrena rugosa, Rob.* ♀, s. and c. p.; (2) *Augochlora vividula, Sm.* ♀, s. and c. p.; (3) *Agapostemon radiatus, Say.,* ♀, c. p.; (4) *Halictus confusus, Sm.* ♀ s. and c. p.; (5) *H. inconspicuus, Sm.* ♀, c. p.; (6) *H. fulvipes, Sm.*

♀, c. p.; Eumenidae: (7) *Odynerus tigris, Sauss.*, s.; Ichneumonidae: (8) *Tryphon seminiger, Cress.* s.; (9) *Campoplex dissitus, Nort.* s.; (10) *Cryptus sp.*, s.

B. Diptera.

Culicidae: (11) *Culex stimulans*, Walk.; Syrphidae: (12) *Mesogramma geminata, Say;* Muscidae: (13) *Pollenia rudis, Fabr.;* (14) *Calliphora vomitoria, L.;* (15) *Phormia regina, Meig.;* (16) *P. terrae-novae, Desv.;* (17) *Lucilia sylvarum, Meig.;* (18) *L. caesar, L.;* (19) *L. sericata, Meig.;* (20) *Pseudopyrellia cornicina, Fabr.;* (21-22) *Clinopera spp.;* Sarcophagidae: (23) *Helicobia helicis, Town.;* (24-26) *Helicobia spp.;* (27) *Sarcophaga sarraceniae, Riley;* (28-33) *Sarcophaga spp.;* Dexiidae: (34) *Myocera cremides, Walk.;* Anthomyidae: (35) *Phorbia fusciceps, Zett.;* (36) *Leucomelina garrula, Gig.—Tos.;* Sapromyzidae: (37) *Lonchaea polita, Say;* (38) *Sapromyza lupulina, Fabr.;* (39) *Sapromyza sp.;* Ortalidae: (40) *Rivellia pallida, Loew,*—all s. or f. p.

C. Lepidoptera.

Rhopalocera: (41) *Neonympha eurytus, F. s.;*

D. Coleoptera.

Cerambycidae: (42) *Acmaeops atra, Lec.;* (43) *A. bivittata, Say;* (44) *Cyrtophorus verrucosus, Oliv.;* (45) *Euderces picipes, Fabr.;* Mordellidae: (46) *Mordella sp.;* Anthicidae: (47) *Corphyra collaris, Say;* (48) *C. lugubris, Say*—all s.

E. Hemiptera.

Capsidae: (49) *Lygus pratensis, L.;* (50) *Poecilocapsus lineatus, Fabr.;* (51-52) spp.—all s.

SMILAX HISPIDA, MUHL. GREENBRIER.

The main factor separating this from the two species considered above is the sweet scent of its flowers. These are open from June 5 to June 28, they bloom together with the late flowers of *S. ecirrhata* and with the flowers of *S. herbacea* during the first half of the latter's flowering season. *S. hispida* is a climbing species, and produces plants 10 to 12 dm. high with pendulous flowers. The number of flowers forming an umbel is small, on an average not exceeding fifteen, and on this account the umbels are less conspicuous than those of the other species.

In 1899 and 1900 the following insects were taken on the flowers:

A. Hymenoptera.

Nomadidae: (1) *Nomada maculata, Cress* ♀, s.; (2) N. americana, Kirby, ♀, s.; Andrenidae: (3) *Andrena forbesii, Rob.* ♀, s.; (4) *A. rugosa, Rob.* ♀, s.; (5) *Andrena sp.* ♂, s.; (6) *Agapostemon radiatus, Say,* ♀, s.; (7) *Halictus coria-*

ceus, Sm. ♀, s.; (8) *H. forbesii, Rob.* ♀, s.; (9) *H. 4 maculatus, Rob.* ♀, s. and c. p.; (10) *H. fulvipes, Sm.* ♀, s.; (11) *Sphecodes dichroa, Sm.* ♀, s.; (12) *S. confertus, Say,* ♂ s.; Prosopidae: (13) *Prosopis modesta, Say,* ♀, s.; Eumenidae: (14) *Odynerus foraminatus, Sauss.*, s.; (15) *O. tigris, Sauss.* s.; Sphegidae: (16) *Ammophila vulgaris, Cress.*, s.; Ichneumonidae: (17) *Tryphon sp. s.;* Evaniidae: (18) *Gasteruption incertum,* Cress., s.

B. Diptera.

Culicidae: (19) *Culex stimulans, Walk.;* Syrphidae: (20) *Syrphus ribesii, L.;* (21) *Allograpta obliqua, Say;* (22) *Mesogramma geminata, Say;* (23) *Helophilus similis, Macq.;* Tachinidae: (24) *Siphona geniculata, DeG.;* Muscidae: (25) *Pollenia rudis, Fabr.;* (26) *Lucilia sylvarum, Meig.;* (27) *L. caesar, L.;* Sarcophagidae: (28) *Helicobia helicis, Town.;* (29) *Sarcophaga, sp.;* Anthomyidae: (30) *Phorbia fusciceps, Zett.;* (31) *Coenosia sp.;* Scatomyzidae: (32) *Scatophaga squalida, Meig.;* Sapromyzidae: (33) *Lonchaea polita, Say;* (34) *Sapromyza lupulina, Fabr.;* (35) *S. quadrilineata, Loew;* Sepsidae: (36) *Sepsis violacea, Meig.;* Oscinidae: (37) *Meromyza americana, Fitch;* Agromyzidae: (38) *Agromyza jucunda,* v. d. W., —all s. or f. p.

C. Coleoptera.

Anthicidae: (39) *Corphyra collaris, Say,* s.

D. Hemiptera.

Capsidae: (40) *Lygus pratensis, L.* s.

In the following table the results obtained from our three species of Smilax are brought together.

		S. ecirrhata.	S. herbacea.	S. hispida.
HYMENOPTERA	Higher bees			2
	Lower bees	4	6	11
	Other Hymenoptera		4	5
DIPTERA	Syrphidae	1	1	4
	Other flies	40	29	16
REMAINING VISITORS		8	12	2
Total		53	25	40

In the list of *Smilax hispida* with its sweet-scented flowers, different families of hymenopterous insects are represented, the higher bees as well as the lower bees, wasps and parasitic Hymenoptera. Among the flies the specialized Syrphidae are present to the number of four. The greenish color of the flowers does not seem to favor the visits of the larger Diptera (macromyiophilous). As regards the proportion of flies to Hymenoptera and other visitors, Smilax hispida corresponds with any sweet-scented flower of a similar structure, as for example any umbelliferous flower with freely exposed nectar, and it offers therefore nothing remarkable.

With *Smilax ecirrhata* and *S. herbacea* the case is different. The list of S. ecirrhata contains only four Hymenoptera, all of them lower bees (Andrenidae) against 41 flies. Among the latter only one is a Syrphus-fly, while of the remaining forty nearly all are flesh-flies or flies of similar food-habits. In the list of *S. herbacea* we find one Syrphus-fly against 29 other flies, and besides, there are ten Hymenoptera represented, most of them lower bees. In this species the preponderance of the flesh-flies and their allies is not as distinct as in the case of *S. ecirrhata* and this may be accounted for by the fact, that the odor of *S. herbacea* is not quite as strong and less putrid than that of *S. ecirrhata.* The flowers of the latter are attractive to the flies of the genera Lucilia, Phormia, Calliphora, Morellia, Helicobia and Sarcophaga to such an extent, that in favorable weather these flies may be seen swarming around the plants, especially when the latter occur in patches. More than once the presence of such flowers, hidden from view by the surrounding vegetation, has been betrayed to me by the gathering of the flies. The bad odor of the flowers does not prevent some of the lower bees of the genera Andrena, Halictus, Agapostemon and Augochlora from collecting pollen on the staminate flowers. Their visits are only occasionally observed and as these same bees rarely resort to the pistillate flowers, they are of little or no advantage as cross-pollinizers. The scarcity of the flower-flies of the family Syrphidae on the flowers of *S. ecirrhata* and *S. herbacea* is remarkable, and shows that the odor of these flowers is not agreeable to them. In fact, I have witnessed a single visit of the same species, *Mesogramma geminata* to each of the sapromyiophilous species of Smilax.

From the above we must infer that the flies which naturally resort to carrion and other decomposing substances are the principal visitors of *Smilax ecirrhata* and *S. herbacea.* They pay attention to both staminate and pistillate flowers, eagerly feeding on honey and pollen, and are undoubtedly of the greatest importance to these flowers as pollen-carriers.

EUONYMUS ATROPURPUREUS, JACQ. WAAHOO.

An account of the pollination of this species, together with a review of the literature dealing with the genus Euonymus and several of its species, was published by Robertson (3) in 1896.

This plant is not common in our neighborhood, but it occurs in several localities in patches, as for example in a large piece of woodland outside of the city limits, north of the Janesville Plank Road. In this locality the observations were made on specimens, varying in height from 1½ to 3 m.

The dark purple flowers are very numerous, and emit a peculiar odor, which is quite different from the odor of the flowers of our sapromyiophilous species of Smilax, and resembles somewhat the smell of sour milk. In size the flowers agree with those from Southern Illinois as described by Robertson. The diameter of the flat, open flower is 8 mm. Each flower has in the middle a dark green, quadrate disc, in the angles of which the stamens are situated, while the style with its light green stigma arises from the center. Proterandry is well marked. The newly opened flower forms a cup, in which the anthers are dehiscent; later on the dark purple lobes of the corolla spread outwardly, and the stigma reaches maturity. Honey is secreted on the disc between the bases of the stamens. The style and the stamens are very short, hardly 1 mm. in length, and, for this reason, Robertson supposes that the feet and proboscides of the insects are the parts through which pollen is mostly transported. Many of the flowers are in a vertical position, but spontaneous self-pollination through the falling of pollen can hardly be expected, as the stigma becomes receptive rather late.

There were no flesh-flies among the 12 visitors taken by Robertson, although, as this author remarks, the disagreeable odor and dark purple color "would probably place it in Delpino's *Tipo melantino,* along with *Euonymus verrucosus*", suggesting an adaptation to flesh-flies.

On six days in June and July of the present year, I have observed these flowers under very favorable conditions; the weather was hot and clear and the plants were covered with flowers. The flowering season extends from June 22 to July 16.

In the following list 29 species of visitors are recorded, but the flowers are poorly attractive to insects, and the small number of individuals present contrasted strongly with the mass of flowers.

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(3) Chas. Robertson, Flowers and Insects, Trans. Acad. Sc. St. Louis, Vol. VII, No. 6, pp. 157-9.

A. Diptera.

Tipulidae: (1) *Pachyrhina pedunculata, Loew;* Syrphidae: (2) *Syrphus americanus, Wied.;* (3) *S. ribesii, L.;* (4) *Allograpta obliqua, Say;* (5) *Baccha aurinota, Walk.;* Tachinidae: (6) *Siphona brevirostris, Coq.;* (7) *Exorista pyste, Walk.;* (8) *E. cheloniae, Rond.;* (9) *Masicera sp.;* (10) *Peleteria robusta, Wied.;* Muscidae: (11) *Pollenia rudis, Fabr.;* (12) *Phormia regina, Meig.;* (13-14) *Clinopera spp.;* Sarcophagidae: (15) *Helicobia sp.;* (16-19) *Sarcophaga spp.;* Anthomyidae: (20) *Spilogaster sp.;* (21-22) *Mydaea spp.;* (23) *Ophyra sp.;* (24) *Phorbia fusciceps, Zett.;* (25) *Pegomyia Sp.;* Sapromyzidae: (26) *Sapromyza quadrilineata, Loew;* Ortalidae: (27) *Rivellia flavimana, Loew;* (28) *Seoptera vibrans, L.*—all s. or f. p.

B. Coleoptera.

Lampyridae: (29) *Ellychna corrusca,* s.

From this list we may infer that the flowers of *Euonymus atropurpureus* are attractive to flies in general, but not particularly to flesh-flies. Syrphidae appear also on the flowers, and of these the two species of Syrphus, figuring on the list, furnished the majority of the visitors on one occasion, on July 4. Of bees I have never witnessed a single visit, although five species of Andrenidae were taken on the flowers by Robertson, as may be seen from the following table:

	Andrenidae.	Syrphidae.	Other Diptera.	Coleopera.	Total.
Carlinville, Ill	5	4	1	2	12
Milwaukee, Wis	......	4	24	1	29

A review of the facts presented in the foregoing, leads to the following conclusions, regarding the effect of the odor of the flowers of our *Smilax-species* and of *Euonymus atropurpureus* on the various types of insect-visitors.

1. The sweet-scented flowers of *Smilax hispida* offer nothing remarkable in this respect, they agree in a general way with any sweet-scented flowers of a similar structure.

2. The flowers of *Smilax ecirrhata* and *Smilax herbacea,* with a putrid odor, are adapted to flesh-flies and the like, while those

of *Euonymus atropurpureus* with a disagreeable but not putrid odor are attractive to flies in general.

3. The specialized flies of the family *Syrphidae* avoid the putrid-scented flowers of *Smilax ecirrhata* and *Smilax herbacea*, but they frequent the flowers of *Euonymus atropurpureus.*

4. The disagreeable odor of the flowers of the two *sapromyiophilous Smilax-species*, as well as of *Euonymus atropurpureus* does not prevent the lower bees of the family *Andrenidae* from visiting these flowers.

Additions to the Flora of Milwaukee County.

By W. J. BENNETTS.

A Third Supplement to "The Flora of Milwaukee County" by W. M. Wheeler.

The following list is in part based on collections and observations made by myself during the past season of 1901. About one-third of the 90 names mentioned, however, have been contributed by five of our local botanists, viz.: W. Finger, P. Wells, H. Russel, J. A. Brandon and E. Bruncken. Acknowledgment is especially due to Mr. Finger who has furnished 19 of the species listed.

A notable feature of this list is the comparatively large number of western species—about 10 may be placed in this class—that the railroads have brought into this region. Some of these, like *Allionia nyctaginea* and *Artemisia gnaphalodes*, have apparently firmly established themselves, and may in time bring about a considerable change in the composition of our local flora. Hence lists which record the appearance of such species in our midst should prove of much interest to future botanists.

The nomenclature followed is that of Britton & Brown's "Illustrated Flora of the Northern United States and Canada" edition of 1898.

List of Species.

832 Acer spicatum Lam. Mountain Maple. In a small cedar swamp in section 20, Town of Milwaukee.

833 Acnida tamariscina tuberculata (Moq.). Uline & Bray. Under the Sixteenth street viaduct near the water's edge.

834 Allionia hirsuta Pursh. Hairy Umbrellawort. West of the town of North Greenfield, west of Wauwatosa, and on the South Side in Chase's Valley; in each case along or near the railway tracks. (W. Finger.)

835 A. nyctaginea Michx. Heart-leaved Umbrella-wort. West of Wauwatosa and of North Greenfield, and in the Menomonee Valley about Twenty-Fourth street; spreading rapidly wherever it has gained a foothold. (Wm. Finger.)

836 Amaranthus blitoides S. Wats. Prostrate Amaranth. A common weed along railway tracks, along streets, and in waste places.

ERRATUM.

(In the second supplement in Bulletin No. 3., Vol. 1)

826. Trillium nivale Riddell. March 26th should be given as its earliest known blooming date and not April 19th.

837 Ambrosia trifida integrifolia (Muhl.) T. & G. Entire-leaved Ragweed. Along the Milwaukee River at Lindwurm, and in the Menomonee Valley just south of the Grand Avenue viaduct. (H. Russel.)

838 Amelanchier spicata (Lam.) De C. Low June Berry. At the top of the bluff of the Menomonee Valley, just northwest of the Wells street viaduct.

839 Amaranthus hybridus paniculatus (L.) Uline & Bray. In boggy flats along the Menomonee and Milwaukee Rivers.

840 Anogra pallida (Lindl.) Britton. White-stemmed Evening Primrose. On newly graded land belonging to the railroad companies near the city limits, and the Kinnickinnik River.

841 Andropogon scoparius Michx. Broom Beard-grass. In Bay View near the rolling mills.

842 Arctostaphylos Uva-Ursi (L.) Spreng. Red Bearberry. On the face of the lake bluffs about a mile north of the village of Whitefish Bay.

843 Anemone Canadensis L. Canada Anemone. Common along the Prairie du Chien divisions of the M. & St. P. Ry. in Wauwatosa near the Hawley road; also near the Lisbon road at the Waukesha county line, along Oak Creek, and in a few other scattered localities. (W. Finger.)

844 Anthemis arvensis L. Field Camomile. Along Lincoln avenue west of Forest Home.

845 Apocynum hypericifolium Ait. Clasping-leaved Dogbane. Common this year on vacant ground along Forest Home Avenue opposite Pilgrim's Rest Cemetery.

846 Arabis brachycarpa (T. & G.) Britton. Purple Rock Cress. In the Menomonee Valley woods near the stone quarries.

847 Artemisia gnaphalodes Nutt. Prairie Mugwort. In the railway yards at the foot of Florida street, in the Menomonee Valley at Twenty-Third street, and on waste ground in a few other parts of the city.

848 Artemisia biennis Willd. Biennial Wormwood. Not rare within the city limits, and also scattered throughout the county. (H. Russel.)

849 Aster ericoides L. White Heath Aster. In section 6 of the town of Greenfield near the Waukesha county line, also along the C. & N. W. Ry. opposite the cement works.

850 A. paniculatus Lam. Tall White Aster. Near the springs in Mineral Spring Park.

851 A. puniceus lucidulus A. Gray. In section 5,, town of Greenfield along railway tracks near a tamarack swamp.

852 Atriplex hastata L. Halberd-leaved Orache. Along the streets of the city. (W. Finger.)

853 Betula lenta L. Black or Sweet Birch. Has been found in section 11, Town of Greenfield, near Lincoln avenue. It is not rare in Ozaukee county.

854 Berteroa incana (L.) D. C. Hoary Alyssum. In section 5, Wauwatosa, north of the Lisbon road in a field. (W. Finger.)

855 Boltonia asteroides (L.) L'Her. Aster-like Boltonia. In section 21, Town of Lake, near the intersection of the old Chicago road and

Clement avenue. Also in section 33, Oak Creek, near the county line. (W. Finger.)

856 Bromus secalinus L. Cheat or Chess. In waste places and grain fields.

857 Cardamine hirsuta L. Hairy Bitter-cress. In Reynolds' Woods, section 6, Town of Greenfield. (W. Finger.) Also in boggy places in Wauwatosa.

858 Carex Sartwellii Dewey. Sartwell's Sedge. In a tamarack, section 5, Greenfield.

859 Cardamine Pennsylvanica Muhl. Pennsylvanian Bitter-cress. In Johnson's Woods, west of Soldiers' Home. (P. Wells.)

860 C. arenicola Britton. Sand Bitter-cress. In the Menomonee Valley near the quarries.

861 Cassia Chamaecrista L. Large-flowered Sensitive Pea. In a vacant lot on Oakland avenue, growing with *Melilotus alba.*

862 Cenchrus tribuloides L. Hedgehog Grass. In Bay View, south of the rolling mills.

863 Croton Texensis (Klatzsch) Muell. Arg. Texas Croton. Near the Kinnickinnic River at the city limits, growing with *Anogra pallida* on the land of the North-Western Railway Co.

864 Cyclanthera dissecta (T. & G.) Arn. Cut-leaved Cyclanthera. In the Menomonee Valley flats opposite Twenty-Third street.

865 Cymbalaria cymbalaria (L.) Wettst. Kenilworth Ivy. A weed in city gardens. (W. Finger.)

866 Cyperus flavescens L. Yellow Cyperus. In a tamarack in section 5, Town of Greenfield.

867 Datura Tatula L. Purple Stramonium. On empty lots Twenty-Ninth and Wright streets. (J. A. Brandon.)

868 Delphinium Carolinianum Walt. Carolina Larkspur. Found occasionally in waste places within the city.

869 Dryopteris spinulosa (Retz.) Kuntze. Spinulose Shield-fern. In a tamarack, section 5, Town of Greenfield (W. Finger.)

870 D. spinulosa intermedia (Muhl.) Underw. In section 27, Town of Lake, in a former tamarack.

871 Eragrostis Eragrostis (L.) Karst. Low Eragrostis. In Bay View.

872 Falcata Pitcheri (T. & G.) Kuntze. Pitcher's Hog Peanut. Common on the lake bluffs at Whitefish Bay.

873 Galium tinctorium L. Wild Madder. In Pierron's grove, section 18, Town of Milwaukee.

874 Gentiana flavida A. Gray. Yellowish Gentian. In a ravine on Dr. Schneider's farm at Fox Point. (W. Finger.)

875 Gleditsia triacanthos L. Honey Locust. Common along the Lisbon Road near the city limits, and along many other roads throughout the county.

876 Helianthus tuberosus L. Jerusalem Artichoke. In the Menomonee Valley near the Hawley Road, and in Mineral Springs Park between the railway embankment and the river.

877 H. Maximiliani Schrad. Maximilian's Sunflower. On the sides of a railway embankment at North Greenfield.

878 Juniperus nana Willd. Low Juniper. Frequent south in woods and pastures near the lake.

879 J. Virginiana L. Red Cedar. In woods in the Town of Franklin.

880 Koellia Virginiana (L.) McM. Virginia Mountain Mint. Along the east bank of the Milwaukee River between River Park and Mineral Spring Park.

881 Lactuca hirsuta Muhl. Red Wood-lettuce. In Wauwatosa along fences.

882 L. Floridana (L.) Gaertn. False or Florida Lettuce. Near the Milwaukee River above Mineral Spring Park.

883 Liriodendron Tulipifera L. Tulip-tree. There are a few shade trees of this species on the East side.

884 Lithospermum canescens (Michx.) Lehm. Hoary Puccoon. West of North Greenfield along the North-Western Ry. tracks. (W. Finger.)

885 Lonicera Sullivantii A. Gray. Sullivant's Honey-suckle. Our commonest species of *Lonicera*, frequent in the thickets of the Menomonee Valley, and less so along the Milwaukee River; also occurs in the growths of *Corylus* and *Hamamelis* that border many of our upland woods. This is doubtless the *L. flava* of Wheeler's list.

886 Lycopus rubellus Moench. Stalked Water Hoarhound. In the Menomonee Valley just above the Wells Street viaduct (J. A. Brandon). Also in Pierron's grove, section 18, Town of Milwaukee.

887 Lychnis alba Mill. White Campion. This species has established itself and is abundant in the State Fair Grounds at North Greenfield. It is also occasionally found along the streets of the city. (P. Wells.)

888 Matricaria inodora L. Scentless Camomile. In vacant ground on Forest Home Avenue, opposite Pilgrims' Rest Cemetery.

889 Melampyrum lineare Lam. Narrow-leaved Cow-wheat. Has been found at Whitefish Bay.

890 Meibomia pauciflora (Nutt.) Kuntze. Few-flowered Tick-trefoil. H. Russel has found this species in Lake Woods.

891 Oxalis corniculata L. Yellow Procumbent Wood-sorrel. A common weed growing with *O. stricta* in city gardens. (W. Finger.)

892 Panax quinquefolium L. Ginseng. I found two plants during the past summer in a beech woods near the lake, in section 36, Town of Oak Creek.

893 Parietaria Pennsylvanica Muhl. Pennsylvania Pellitory. A weed in city gardens. (W. Finger.)

894 Peramium pubescens (Willd.) McM. Downy Rattlesnake-plantain. In section 32, Town of Oak Creek, near the county line. (W. Finger.)

895 Pentstemon Digitalis (Sweet.) Nutt. Foxglove Beard-tongue. In section 5, Wauwatosa, and in section 16, Town of Milwaukee. (W. Finger.)

896 Physalis heterophylla Nees. Clammy Ground-cherry. In stubble fields, section 9, Town of Oak Creek. (J. A. Brandon.)

897 P. Virginiana Mill. Virginia Ground-cherry. Was found during the past season growing in considerable numbers in open ground in section 34, Greenfield, just east of the State Fair Grounds.

898 Physostegia parviflora Nutt. Western Lion's Heart. In the Menomonee Valley near the Grant Marble Works.

899 Polygala Senega latifolia T. & G. In woods, near the waterworks in Wauwatosa.

900 Potamogeton pectinatus L. Fennel-leaved Pondweed. There is a specimen in the Public Museum herbarium collected by T. A. Bruhin along the shores of Lake Michigan at Milwaukee.

901 Polygonum emersum (Michx.) Britton. Swamp Persicaria. In muddy flats of the Menomonee Valley, Wauwatosa.

902 P. orientale L. Prince's Feather. In many vacant lots and waste places within the city limits.

903 Ranunculus septentrionalis Poir. Marsh Buttercup. By the side of M. & St. P. Ry. tracks west of Soldiers' Home. (J. A. Brandon.)

904 Ribes prostratum L'Her. Fetid Currant. Has been found in Wauwatosa by F. Runge. It occurs not rarely in the counties to the north of us.

905 R. gracile Michx. Missouri Gooseberry. Common throughout the county.

906 Ricinus communis L. Castor Oil Plant. In waste places along Clybourn street.

907 Robinia Pseudacacia L. Black Locust. Common along fences and roads in Wauwatosa.

908 Rubus Baileyanus Britton. Bailey's Blackberry. In woods near the cement works on the Milwaukee River. (W. Finger.)

909 Rynchospora glomerata (L.) Vahl. Clustered Beaked Rush. In the Menomonee Valley near Mitchell Park.

910 Sericocarpus linifolius B. S. P. Narrow-leaved white-topped Aster. Near North Milwaukee.

911 Solidago rigida L. By the roadside just north of the cement works on the Milwaukee River.

912 Solanum Carolinense L. Horse Nettle. In the Menomonee Valley about Thirtieth street. (W. Finger.)

913 Stipa spartea Trin. Porcupine Grass. In Bay View south of the rolling mills.

914 Thalictrum purpurascens L. Purplish Meadow-rue. At Whitefish Bay and elsewhere in damp soil.

915 Thalesia uniflora (L.) Britton. One-flowered Broom-rape. North of Whitefish Bay (W. Finger). Also in thickets near the springs in Mineral Spring Park. (Dr. S. Graenicher.)

916 Triglochin palustris L. Marsh Arrow-grass. Common along the lower face of the lake bluffs at Whitefish Bay on the boggy terraces.

917 Veronica Byzantina B. S. P. Byzantine Speedwell. At Fox Point, a weed in gardens (W. Finger). It has been found also within the city.

918 Vicia sativa L. Common Tare. Common in grain fields north of Whitefish Bay, also in city gardens.

919 Viola scabriuscula (T. & G.) Schwein. Smoothish Yellow Violet. Common in rich moist woods.

920 V. ovata Nutt. Ovate-leaved Violet. In the Menomonee Valley just west of the Wells street viaduct, and in section 36, Oak Creek. (E. Bruncken.)

921 V. sororia (Willd.) Wooly Blue Violet. Frequent throughout the county. (E. Bruncken.)

Contribution Towards a List of Milwaukee County Fungi.

By CHAS. E. BROWN and VALENTINE FERNEKES.

Since the fall of 1899, an effort has been made by ourselves, assisted by other members of the Wisconsin Natural History Society, to establish at the Milwaukee Public Museum for the purpose of public instruction, a collection of the more common species of Milwaukee County fungi. The seasons of 1900 and 1901 being particularly favorable to such growth, a considerable number of these and of the less frequently occurring forms were collected in various parts of the city and county, and many of these have been prepared, determined and placed upon exhibition in the museum halls.

In Milwaukee as elsewhere, the number of persons, who are learning to appreciate the worth of fleshy fungi as a welcome addition to our table delicacies, is on the increase and such a collection, as we have attempted to institute, has already been, we have reason to believe, of material aid to many in this respect.

Of the number and distribution of our local species but little is known, and it is hoped that the present work may be continued and that the material thus assembled may prove of value in case the publication of a complete list of Wisconsin fungi is ever attempted.

In the preparation of the present list, the works of Peck and other authors have been freely consulted.

To the Messrs. E. E. Teller, Ernest Bruncken, J. A. Brandon, W. J. Bennetts, A. F. Laue and other members of the Wisconsin Natural History Society, we are indebted for assistance in collecting, and to Rev. Chas. J. McNeill and Dr. R. A. Harper of Madison, for determining certain doubtful forms.,

Of the 100 species listed, 44, or numbers: 1, 4, 5, 6, 11, 13, 14, 15, 20, 23, 26, 29, 31, 33, 34, 35, 49, 51, 52, 53, 54, 56, 57, 59, 60, 61, 62, 65, 67, 70, 71, 76, 77, 78, 80, 85, 89, 90, 93, 94, 95, 96, 98 and 100 have been previously recorded from other parts of the state in W. F. Bundy's "Partial List of Wisconsin Fungi," published in Vol. I. of the Geology of Wisconsin, 1873-76.

*1. Agaricus campestris, Linn. Common Mushroom. Appears as early as May and occurs in the greatest abundance in September and October. Common on lawns, lots and parks all over the city. Sometimes in patches of considerable extent.

2. Agaricus arvensis, Schaeff. Horse Mushroom. Common in the fields and pastures of the county. Also occasionally occurring in the city.

3. Agaricus argenteus, Braendle. Silver Agaric. Specimens collected in mixed woods opposite Humboldt on the Milwaukee River. September 29, 1901.

*4. Agaricus silvicola, Vittad. Wood Agaric. On ground in mixed woods opposite Humboldt on the Milwaukee River. October 8, 1901.

*5. Amanita phalloides, Fr. Deadly Amanita. In Johnson's and other woodlands west of the city. October 1900 and 1901. Occasional specimens of the yellow form have also been found there.

*6. Amanita verna, Bull. Spring Amanita. Growing on grass lots near Oakland Ave. in the city. October 10, 1900.

7. Amanita frostiana, Pk. Frost's Amanita. A number of these richly colored plants were obtained from a hollow beneath the roots of a large oak near the Blue Mound Road in Town Wauwatosa on October 11, and again on October 20, 1901.

8. Amanitopsis vaginata, Roze. Sheathed Amanitopsis. In mixed woods near Whitefish Bay, September 13, 1901.

9. Amanitopsis vaginata, Roze, var. fulva. Schaeff. Single specimens have been found in mixed woods near Whitefish Bay, September, 1901.

'10. Amanitopsis strangulata, Roze. Choked Amanitopsis. August 30, 1901. Several specimens were obtained in open woods near the Country Club.

*11. Armillaria mellea, Vahl. Honey-colored Armillaria. Common in the woods of the country. Also along city streets, growing at the bases of trees and from buried roots on lawns. Growing in great quantity from cracks on top of rotting stumps and about the bases of trees and stumps in the southern part of Johnson's woods, Town Wauwatosa, during late September and early October, 1901.

12. Clavaria botrytes, Pers. In mixed woods near Whitefish Bay, September 12, 1901.

*13. Clavaria cristata, Pers. Crested Clavaria. The most common of our local clavarias. Growing in rich soil near logs and stumps, August and September.

*14. Clavaria coralloides, Linn. Coral Clavaria. Several fine specimens found in Johnson's woods, Town Wauwatosa, August 27, 1900.

*15. Clavaria inaequalis, Fl. Unequal Clavaria. Solitary plants collected in woods, opposite Humboldt, on the Milwaukee River, September, 1899.

16. Clavaria muscoides, McIlv. Moss Clavaria. In pasture, near Mineral Spring Park, October 17, 1900.

17. Clavaria pistillaris, Linn. Pestle-like Clavaria. Several fine lots of this plant, of a light reddish-brown color, were collected in mixed woods, near the Country Club, October 10, 1900.

18. Clavaria pyxidata, Pers. Box-tipped Clavaria. Found but once. Specimens growing in rich soil near a rotting log in Reynolds' woods, near Layton Park, October 9, 1900.

19. Clavatia craniformis, Schw. Skull-shaped Lycoperdon. In open woods, near Lake Park, October 11, 1900.

*20. Clavatia gigantea, Batsch (Lycoperdon giganteum, Batsch). Giant Puff Ball. Common throughout the county in wooded pastures and fence corners during September and October in favorable seasons.

21. Clitocybe decastes, Gr. Clustered and single. Growing on piles of bran and sawdust near North and Oakland Avenues, September 15, 1901.

22. Clitocybe illudens, Schw. Deceptive Clitocybe. Appears to be common throughout the country. We have collected it as early as August 12 and up to October 15, generally from stumps and roots of oak and elm.

*23. Clitocybe laccata, Scop. Lac Clitocybe. Growing in grass in Johnson's woods, Town Wauwatosa, and in mixed woods near Lake Woods, September 12, 1900.

24. Clitocybe media, Pk. Intermediate Clitocybe. In mixed woods near the Country Club, October 17, 1900.

25. Clitocybe multiceps, Pk. Many-headed Clitocybe. Plants growing singly and in clusters on well-manured lawn at

Sixteenth and Prairie Sts., October 10, 1901. Also near North Avenue, October 6, 1901.

*26. Clitocybe nebularis, Batsch. Clouded Clitocybe. In mixed woods near Whitefish Bay, October 10, 1901.

27. Clitocybe robusta, Pk. Robust Clitocybe. In mixed woods opposite the Cement Mills on the Milwaukee River, October, 1900. Tompkins' woods, South Milwaukee, October 5, 1901.

28. Clitophilus abortivus, B. & C. Aborted Clitocybe. With aborted form in Johnson's woods, September 6, 1900. In crataegus thickets in Downer College woods, October 10, 1900.

*29. Clitophilus prunulus, Scop. Prune Mushroom. With aborted form in mixed woods near Wauwatosa, September 23, 1901. Tompkins' woods, South Milwaukee, October 5, 1901. Near Mineral Spring Park.

30. Collybia radicata, Rehl. Rooted Collybia. Common in woods throughout the county. Occurring also on lawns in the city. We have collected it from early August to October.

*31. Collybia velutipes, Curt. Velvet-footed Collybia. Common in the city and county, especially in the autumn on stumps and tree trunks. We have found it as late as November 24.

32. Collybia dryophila, Bull. Oak-loving Collybia. In mixed woods near the Country Club, October 24, 1900.

*33. Coprinus atramentarius (Bull.) Fr. Very common, especially along the city streets on lawns, etc. August too as late as November 1. The scaly form is probably the least common.

*34. Coprinus comatus, Fr. Shaggy-mane. During September and October, one of our most common mushrooms. Growing in greatest quantity on filled land and rubbish piles beneath the Sixteenth Street viaduct. The horse manure which sifts through the flooring and blows over the side of that structure has greatly enriched the ground beneath, making the spot a favorable one for the growth of this and other fleshy fungi. Occuring also on lawns and vacant lots in the city.

*35. Coprinus micaceus (Bull) Fr. Glistening Coprinus. Very common, especially along the city streets. Spring to late autumn. In large clusters and successive crops.

36. Coprinus tomentosus (Bull) Fr. Hairy Coprinus. A small cluster was found growing on an old broom in the basement of the Pabst Theatre Building, April 2, 1900. On dung heaps in the Menomonee Valley in the city, October 8, 1901.

37. Daedalea unicolor (Bull), Fr. On basswood stump in the Menomonee Valley, near the Miller Brewery, October, 1900.

38. Dictyophora duplicata (Bosc.), Ed. Fisther. Net Bearer. A number of plants were collected in mixed woods near Mineral Spring Park, October 19, 1900.

39. Favolus europaeus, Fr. In Johnson's woods on dead twigs and branches, July 10, 1901. Near Wauwatosa village.

40. Helvella crispa, Fr. White Helvella. In mixed woods at Lindwurm, September 9, 1900.

41. Helvella lacunosa, Afzel. Pitted Helvella. Country Club woods, October 11, 1901.

42. Hygrophorus virgineus, Fr. Ivory Cap. In grassy places in woods, on the east side of the Milwaukee River, opposite Humboldt, October 31, 1900.

43. Hydnum caput-ursi, Fr. Bear's Head Hydnum. Handsome specimens of this and the three succeeding species have been collected after each heavy rain from the top and sides of two beech logs, in a raspberry thicket, in woods opposite Humboldt, on the Milwaukee River. During 1900, our first specimens were obtained at about the middle of August, and the last in early November, just before the first heavy frost. During 1901, they have been equally abundant at the same place, the different forms often touching each other, but not arranged in regular series of any kind. The fifth species being collected with the others for the first time.

44. Hydnum caput-medusae, Bull. Medusa's Head Hydnum. Also found on log at Reynolds' woods, October 4, 1901.

45. Hydnum erinaceus, Bull. Hedge-hog Hydnum.

46. Hydnum acciculare, Sac.

47. Hydnum coralloides, Scop. Coral Hydnum. On beech log in woods opposite Humboldt, on the Milwaukee River, September 19, 1901.

48. Hypholoma incertum, Pk. In woods on the Oaks Farm, Cudahy, August 23, 1901. Whitefish Bay, June to Septemper, 1901.

*49. Hypholoma perplexum, Pk. Perplexing Hypholoma. Base of oak tree, Siegel's Farm, Cudahy, October 4, 1901. In mixed woods near Fox Point, October 7, 1901.

50. Hypholoma sublateritum, Schaeff. Brick-red Hypholoma. Common throughout the county. Growing on stumps and from underground roots. Occurs also in the city. During October and up to November 1, 1900, successive crops appeared from a wound on the limb of an elm, 20 feet from the ground, at Eleventh and Cedar Sts.

*51. Hypholoma lachrymabundum, Fr. Weeping Hypholoma. Near 32nd and National Avenues, September, 1900.

*52. Lactarius chrysorrheus, Fr. August 23, 1900. Johnson's woods, Town Wauwatosa.

*53. Lactarius insularis, Fr. Tasteless Lactarius. September 10, 1901. In woods opposite the Cement Mills.

*54. Lactarius piperatus (Scop.), Fr. Peppery Lactarius. We have collected this species from the middle of August to the last of September, near the Cement Mills, Downer College, and in Reynolds' woods on the Janesville Plank Road.

55. Lepiota morgani, Pk. Morgan's Lepiota. Four fine specimens, each measuring about 8 inches across the pileus and with a stipe about 8 inches high, were collected in a wet, grassy pasture at North Milwaukee, on September 15, 1900.

*56. Lepiota naucina, Fr. Smooth Lepiota. Common on lawns, hillsides, pastures and cultivated fields near the city, from July to October. During a particularly wet summer season several years ago, this mushroom was so common in the potato fields of the county that wagon loads of it were brought in to market by the farmers.

*57. Lepiota procera, Scop. Parasol mushroom. Common in pastures and open woods of the county and occasionally found growing on lawns in the city. We have collected it from late August to October.

58. Lycoperdon Curtisii, Berk (Lycoperdon wrightii, var typicum, Pk.). Curtis' Lycoperdon. September 29, 1900. Growing on grass lots near Lake Park.

*59. Lycoperdon cyathiforme, Bosc. Cup-shaped Lycoperdon. October 20, 1900, Johnson's woods, Town Wauwatosa. October 10, 1900, in mixed woods near Whitefish Bay. October 15, 1901, near Carrollville.

*60. Lycoperdon gemmatum, Batsch. Gemmed Lycoperdon. Common in woods and open places in the county, from the last of August to the middle of October.

*61. Lycoperdon pyriforme, Schaeff. Pear-shaped Lycoperdon. Growing on rotting wood, stumps and logs in the county. Most abundant during October.

*62. Lycoperdon wrightii, B. and C., var seperans, Pk. Wright's Lycoperdon. On grass lots near Lake Park, September, 1900. Not common.

63. Marasmius oreades, Fr. Fairy Ring Mushroom. On elevation in grassy pastures near North Milwaukee, September 30 to October 10, 1901. Forming rings 5 to 12 feet in diameter.

64. Merulius tremellosus, Schrad. Trembling Merulinus. Spread over bark of maple log in woods near the end of National Avenue, October, 1900.

*65. Morchella esculenta, Pers. Esculent Morel. Specimen brought to us from Oak Creek, where it is occasionally gathered in small quantities after rains in late spring and early summer. It also occurs at Fernwood and in the Fish Creek ravine in the northern part of the county.

66. Omphalia campanella, Batsch. Bell Omphalia. Several fine clusters of thirty or more individuals were collected from the top of a rotting beech log in mixed woods opposite Humboldt on the Milwaukee River, August 26, 1901.

*67. Peziza aurantia, Pers. Golden Peziza. In great numbers on the ground, Reynolds Woods, September 23, 1900; October 10, 1900, Downer College woods; September 12, 1901, Oaks' Farm, Cudahy; September 27, 1901, Johnson's woods, Town Wauwatosa.

68. Peziza acetabulum, Linn. Cup-shaped Peziza. June 13, 1901. A single specimen obtained in Johnson's woods.

69. Peziza badia, Pers. Bay-brown Peziza. Growing singly and clustered among oak,leaves,at the margin of a slight depression, in clayey soil, at Johnson's woods, July 12, 1901.

*70. Peziza coccinea, Jacq. Fairy Cup. Mitchell's woods, Layton Park, on fallen twigs. Usually a single specimen on a twig. September 23, 1900. Country Club woods, October 10, 1900.

*71. Phallus impudicus, Linn. Fetid Wood-Witch. August, 1899. In woods near 39th Avenue, in the city. September 12, 1900. In woods near Downer College.

72. Pholiota adiposa, Fr. Fatty Pholiota. Clusters of five to ten plants growing from wounds six feet up the trunk of a chestnut tree on the Deutscher Club grounds, in the city, September 25 to October 8, 1901. Specimens gathered from the same tree last year. Growing from wound on trunk of soft maple, 12th and State streets, September 23 to October 11, 1901. Reynolds' woods, Layton Park, October 4, 1901.

73. Pleurotus dryinus, Pers. Oak Pleurotus. A small cluster growing from a wound, on the trunk of an oak tree, near Whitefish Bay, October 17, 1900.

74. Pleurotus ostreatus, Jacq. Oyster Mushroom. Common from July to November on dead trunks and branches of elm and oak in the woodlands of the county. An unusual growth of large clusters observed on October 6, 1901, in the National Soldiers' Home grounds, covered the entire side of a dying elm tree [two and one-half feet in diameter] from the roots to a point about ten feet up the trunk.

75. Pleurotus sapidus, Kalchb. Savory Pleurotus. Collected from dead tree trunk in Johnson's woods, Town of Wauwatosa, October 15, 1900. Another large and handsome specimen was obtained from a log of green wood, which had lain for several months in the cellar of a residence, at 21st and Grand Avenue.

*76. Pleurotus ulmarius, Bull. Elm Pleurotus. Very common, especially in the city, growing from pruned limbs or crotches of living elm trees, during September and October. Usually from two to three plants in a cluster.

*77. Pluteus cervinus, Schaeff. Brown Pluteus. Common in mixed woods near Whitefish Bay, August and September, 1901. Occurring also at Cudahy and in Johnson's woods.

*78. Polyporus adusta, Fr. Scorched Polyporus. On stump, in woods, at Buckhorn, Town Lake, October, 1901.

79. Polyporus applanatus (Pers.) Fr. Common Polyporus. The most common of our woody fungi. Growing on stumps and sometimes from wounds of living trees. Several interesting examples, where the fungus, projecting from a tree stump, had completely enveloped a young sapling which had grown up from the ground near it were brought to us by Rev. C. J. McNeill.

*80. Polyporus brumalis (Pers.) Fr. Winter Polyporus. Specimens of this interesting fungus were found growing on a stump in mixed woods, opposite the cement mills, on the Milwaukee River, October 12, 1900.

81. Polyporus frondosus, Fr. Leafy Polyporus. Two large specimens of a grayish color were found growing on an old stump in woods near the Country Club, September 12, 1900. From roots of an oak near Whitefish Bay Village, October 4, 1901.

82. Polyporus gilvus, Schw. Growing on basswood stump, in the Menomonee Valley, west of the city, October 10, 1901.

83. Polyporus lucidus (Leys) Fr. Lucid Polyporus. On stump near Tippecanoe Lake, Town Lake, Milwaukee County, October, 1900.

84. Polyporus resinosus, ——. Resin Polyporus. On stumps near Whitefish Bay, October 12, 1900.

*85. Polyporus sulphureus (Bull) Fr. Sulphur Polyporus. Fine specimens were collected from a large stump in Mitchell's woods, Town Greenfield, September 24, 1900; from trunk of living oak in Country Club woods, October 10, 1900; from dead oak trunk, Johnson's woods, September 12, 1900; and from wounds on the bark and roots of a basswood tree near Wauwatosa, September 17, 1901.

86. Polystictus cinnabarinus (Jacq.) Fr. Red Polystictus. On oak stumps, Layton Park, October 21, 1900. Tompkin's woods, South Milwaukee, October 6, 1900.

87. Polystictus conchifer, Schm. On dead twigs, Menomonee Valley, April, 1901. On small trunks and limbs of ash, Johnson's woods, October 6, 1901.

88. Polystictus versicolor (L.) Fr. Many-colored Polystictus. Common throughout the county on stumps and branches of oak, maple, basswood, etc. Some very handsome growths were collected from the trunks of dead and dying peach trees in city gardens.

*89. Polystictus hirsutus, Fr. Hairy Polystictus. Common in the county on stumps, limbs, etc.

*90. Psathyrella disseminata, Pers. Scattered Psathyrella. Common on lawns and near bases of shade trees, along city streets, August and September, 1901. In woods at Oaks farm, Cudahy, September 10, 1901.

91. Russula adusta (Pers.) Fr. Scorched Russula. September 20, 1901. In mixed woods, opposite the cement mills; on the Milwaukee River. October 10, 1900, in Dahlman's woods, near Whitefish Bay.

92. Russula alutacea, Fr. Leathery Russula. Common during August and September, 1900 and 1901, in woods extending from the city limits to Whitefish Bay. September, 1901, in Johnson's woods, Town Wauwatosa.

*93. Russula emetica, Fr. Emetic Russula. Specimens collected in Johnson's woods, Town Wauwatosa; in birch woods at Fox Point; and in woods near the Country Club, September, 1900 and 1901.

*94. Schizophyllum alneum, (L.) Schroet. (Schizophyllum commune, Fries). Common throughout the county, on branches, trunks, etc. We have collected it on oak, hickory and linden.

*95. Scleroderma vulgare, Fr. Common Scleroderma. October 23, 1900, and October 4, 1901, in woods, opposite Humboldt, on the Milwaukee River.

*96. Strobilomyces strobilaceus, Berk. Cone-like Boletus. July 31, 1900, in woods near Lake Station; August 12, 1900, in Reynolds' woods, on the Janesville Plank Road. August 20, 1901, in Johnson's woods, Town Wauwatosa.

97. Trametes peckii, Kalchb. Peck's Trametes. On cottonwood stump in the Menomonee Valley, west of the city, October, 1901.

*98. Tremella fimbriata, Pers. Fringed Tremella. On oak stump, in mixed woods west of the cement mills, September 10, 1901.

99. Tremella fuciformis, Berk. Spindle-shaped Tremella. On leaf mold, in mixed woods near Lake Park, October 9, 1900.

*100. Tremella lutescens, Pers. Yellow Tremella. Common on rotting limbs and logs of oak, in Country Club woods, October 10, 1900.

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*Mentioned in W. F. Bundy's List published in Vol. 1 of Geo. of Wis. (1873-'76.)

Notes on a Collection of Hamilton Fossils, from the Town of Bethany, Genesee Co., N. Y.

By CHARLES E. MONROE.

The writer's first acquaintance with Devonian fossils was made in connection with the hydraulic limestone beds in the neighborhood of Milwaukee. These beds are rich in the remains both of fishes and invertebrates and are remarkable for the mingling of forms which are elsewhere widely separated geographically and vertically. The study of these forms and their proper determination and correlation necessitated more extensive investigations and an acquaintance with the fossils of other localities. In the progress of such investigations trips have been made into Iowa, Michigan and Ontario and interesting collections secured at Hackberry Grove, Petoskey and Thedford, all famous localities for fossils. Last May a visit was made to the town of Bethany, in Genesee County, N. Y., where for the first time the writer had an opportunity to secure a large collection from the classical ground of the New York Hamilton. The principal localities visited were a couple of points on the line of the Lackawanna railroad, one a cut through a few feet of rock a mile and a half west of the village of East Bethany, the other the flat but narrow valley of a little brook crossing the railroad a mile and a half still farther west. A brick-yard by the highway, a mile south of the village, furnished good specimens of *Spirifer marcyi* and *Tropidoleptus carinatus,* being the only locality where these two species were obtained. In the shales exhibited on the banks of a stream flowing through the same farm a fine crinoid was obtained, and in the banks of the same stream at a point nearer the village many small fossils were found in concretions of iron pyrites, among the most notable being specimens of *Goniatites uniangularis.* The water, however, was too high to permit a thorough examination of these shales, and far the larger portion of the collection was obtained from the slopes of the railroad cut and from low mounds of disintegrated material in the valley of the little brook first mentioned.

The railway cut near East Bethany is from twelve to fifteen feet in depth, the encrinal limestone showing at the top of the slope. There is also a cut many feet deep at the crossing of the little brook to the west; but the shales there exposed are apparently barren, except at the highest point, where a few large specimens of *Spirifer granulosus, S. mucronatus* and *Athyris spiriferoides* were found. At the bottom of this valley the encrinal limestone is visible in the bed of the creek, dipping to the west. East of this point a few feet of the lower shales are seen, but they are mostly barren of fossils. This paper, however, is not intended as a study of horizons; but a list of the fossils collected will be given, with some notes on their geographical distribution and such other observations as may be suggested by a study of the specimens.

One thing especially noticeable is the striking resemblance between the Bethany and Thedford faunas. There is also a remarkable similarity in the manner in which the fossils are concentrated in both places in the neighborhood of the encrinal limestone, either in the limestone layer itself or in the strata immediately contiguous to it. The shales at Thedford are of a different character from those at Bethany, being lighter in color and softer, quickly breaking down into a tenacious clay. The limestone is similar in the two localities and holds the same position between great thicknesses of softer rocks.

Among the fossils first described from Thedford, but common to both localities, are the following—twenty-nine species in all—some of which have not before, so far as the writer is aware, been reported from New York:

Alveolites goldfussi, Ascodictyon fusiforme, A. stellatum, Botryllopora socialis, Camarotoechia thedfordensis, Cladopora fischeri, C. roemeri, Cornulites intermedius, Favosites clausus, F. placenta, Fistulipora huronensis, F. subtrigona, Hederella canadensis, H. filiformis, Heliophyllum juvene, Heterotrypa barrandei, H. moniliformis, Leptotrypa quadrangularis, Leiorhynchus laura, Monilopora antiqua, Pinacotrypa elegans, Spirorbis arkonensis, Streblotrypa hamiltonensis, Striatopora linnaeana, Stromatopora mammillata, Stromatoporella granulata, Syringopora nobilis, Taeniopora exigua and *Trachypora elegantula.*

Nicholson's *Stromatoporella nulliporoides* might have been included in the foregoing list. But this species, having been identified with *S. incrustans*, described by Hall and Whitfield from Iowa, the former name, being the later of the two, gives way to the other. *Pinacotrypa elegans* (Rominger) is plainly identical with *P. serrulata* (Hall), and *P. proporoides* (Nicholson) is probably the same as *P. plana* (Hall), Hall's names being superseded by Rominger's and Nicholson's. Nicholson's *Ortonia intermedia* is also apparently identical with Grabau's *Cornulites hamiltoniae* and must stand in the place of the latter. The proper generic name, however, would seem to be *Cornulites. Leiorhynchus laura* (Billings) is the same as *L. multicosta* Hall and has priority over the latter.

Whiteaves was the first to point out that *Hederella filiformis* (Nicholson) is not the same as Billings's *Aulopora filiformis*, and he gives a drawing of Billings's type specimen showing the latter to be truly an *Aulopora*. The writer collected a single fine specimen at Thedford which corresponds exactly with Whiteaves's drawing, and appears to be identical with specimens of *Aulopora iowaensis* Hall and Whitfield, previously collected at Hackberry, Ia. If this identification is correct the latter name has priority over Billings's; and *Hederella filiformis* must be credited to Nicholson and not to Billings.

Specimens of *Favosites clausus*, both from Thedford and Bethany, show a tendency to laminar expansion and the species may be merely a variety of *F. placenta*. It is a question whether *Cystiphyllum corrugatum* Hall, from Bethany, is not identical with *C. vesiculosum* Goldf., noted by Nicholson from Thedford.

There were collected at Bethany three species, at least, which were originally described from Iowa. These are *Stromatopora expansa, Stromatoporella incrustans* and *Lioclema occidens*. The latter is not known to have been hitherto reported from New York. It is an abundant species at Hackberry, Ia., Callaway County, Mo., and Milwaukee. A number of solid forms, apparently of this species, were collected at Bethany. Other interesting examples of species originally described from western localities are *Astraeospongia hamiltonensis* and *Intrapora puteolata*, of each of which a beautiful example was obtained.

The crinoid above referred to most nearly resembles *Thylacocrinus clarkei* Wachsmuth and Springer, but differs from the illustration given of that species in this, that the apices of the angles of the polygonal plates have a truncated appearance, or rather the appearance of having been pushed inward by some sharp instrument which has perforated the calyx at the points of juncture of the plates. This Bethany species cannot be very rare, for the writer has another specimen of the same kind which was collected at Canadaigua Lake.

Several hundred specimens belonging to the genus *Fistulipora* and related genera were collected and much time has been spent in their study and determination. The works consulted are Hall and Simpson's volume on the New York *Bryozoa*, Ulrich's work on the *Bryozoa* of Illinois, Nickles and Bassler's Synopsis of American Fossil *Bryozoa*, Nicholson's Reports on the Paleontology of Ontario, and papers by Nicholson in the Annals and Magazine of Natural History and by Rominger in the Transactions of the Philadelphia Academy of Sciences. With such a quantity of good material it was not anticipated that there would be much difficulty in determining the species. Having in mind the beautiful illustrations in Hall and Simpson's great work, and the number of trained paleontologists who had been over the same ground and given the results of their labors in the description of a large number of distinct species, the writer started in on the work of identification with a cheerful confidence which was all too soon overthrown. The elaborate descriptions and elegant drawings, which seem so plain on their face, give no idea of the astonishing variations and obscurities presented by the specimens themselves. Quite a number of the species collected have certainly never been described; and among the others there are such variations in size and shape of apertures, height and obliquity of peristomes, as well as in the plainness of vesicular openings, appearance of maculae and monticules and character of inter-apertural surface generally, that the labor, in spite of its fascination, has been unexpectedly great. Hall and Simpson's diagnoses show the artificiality of their distinction between the genera *Lichenalia* and *Fistulipora* and this is further emphasized by the confusion into which they themselves have sometimes fallen, as shown in cross-references in which a species is sometimes referred to one genus and sometimes to the other. The distinction which they make, based upon the presence or absence of superficial openings of the interapertural vesicles, cannot be maintained. But Ulrich's distinction between *Fistulipora* and *Pinacotrypa,* depending upon the presence in the latter of tubular mesopores in the place of the vesicular structure of the former, is not entirely free from the charge of arbitrariness, as there seem to be all degrees of gradation between these two types. Nickles and Bassler, the latest authorities, show a noticeable lack of confidence in deciding between the two genera. In addition to all these difficulties it is clear that Hall and Simpson have not examined Rominger's and Nicholson's types and have added to the confusion by the unnecessary introduction of synonyms. Even the genera *Pinacotrypa* and *Lioclema* do not always show a clear line of separation, although they have been placed in different families and even different suborders. The divergence between such forms as *Pinacotrypa scrobiculata, P. unilinea. P. hemispherica, Lioclema spheroideum, L. confertiporum* and *L. segregatum,* seems like a very gradual one and would indicate a tolerably close relationship.

Certain groups of species are clearly distinguishable, among them the following:

Pinacotrypa operculata-stellata-umbilicata-variopora; P. elegans-plana-proporoides-scrobiculata-serrulata; Fistulipora trifaria-vesiculata; F. colliculata-cultellata-longimacula-triangularis;

a larger aggregation including *F. constricta-cornuta-eriensis-inter-aspera-ramosa-spinulifera-utriculus* and others; and the group of species included under the genus *Lioclema.* Many of the specimens fall easily into their places under some of these specific names; but a large number exhibit variations which make it difficult to do more than to assign them to one or another of these groups and even throw doubt upon the validity of some of the specific distinctions. The same individual may exhibit upon different portions of its surface differences which have been given specific values. The specimens identified with *Pinacotrypa bullata* agree with the description of that species in every respect except in their manner of growth, having a solid zoarium, with cells opening on all sides. Three entirely distinct forms, with very oblique openings, have with some hesitation been identified as *Fistulipora foliacea, F. huronensis* and *F. imbricella*—the hesitation somewhat increased by Nickles and Bassler's declaration that the last named species is unrecognizable.

In respect to the genus *Lioclema* the authorities last named suggest a doubt as to the validity of the numerous distinctions recognized by Hall and Simpson. This doubt does not always seem to be entirely justified. It is not difficult to distinguish quite a number of the forms described, though it may, perhaps, be a question whether they ought to be designated as species or merely as varieties. Indeed there is a temptation to add to the number a beautiful form, apparently different from any so far described, with excessively small apertures and mesopores, monticules with sterile centers occupied by mesopores, the adjacent apertures streaming off in rows and diminishing in size as they recede from the center, the peristomes both of zooecia and mesopores crowned with minute spines.

There is a difference between the Thedford and Bethany fossils of this group in the preservation of surface characters. Specimens from the former locality frequently have a glazed appearance, with the zooecial apertures and vesicular openings closed by a calcareous deposit.

Among the slender, rod-like forms of *Bryozoa* several examples were collected at Bethany, fragmentary for the most part, and generally only one or two of a kind. The determination of these forms has not always been satisfactory, and is mainly limited to the genera. Many fragments of *Fenestellidae* were also collected, but no attempt has been made to give them names.

In the subjoined list Nickles and Bassler's Synopsis has been followed in respect to the *Bryozoa*, with the exception that species which are by them assigned to *Fistulipora,* with the suggestion that they may prove to belong to *Pinacotrypa,* have been placed under the latter genus. Schuchert's Synopsis has been followed in the case of the *Brachiopoda.* For the Corals Rominger's work on the Corals of Michigan and Hall's illustrations of Devonian Fossils have been carefully studied. Whiteaves's lists of Thedford fossils have been very helpful and his designations have been adopted in most cases outside of the *Bryozoa* and *Brachiopoda.* Grabau's Monograph on the Fossils of Eighteen-mile Creek has also been consulted. To the authorities already named should be added Billings's series of papers on the devonian fossils of Canada West, published in the Canadian Journal in 1859 and 1860. For the opportunity to examine these valuable and not easily obtainable papers the writer is indebted to the kindness of Rev. Hector Currie, of Thedford, Ontario.

List of Fossils from Bethany, N. Y.

PORIFERA.

Astraeospongia hamiltonensis Meek and Worthen.

COELENTERATA.

Alveolites goldfussi Billings.
Aulopora serpens Goldfuss.
A. *one or two additional species.*
Blothrophyllum conatum (Hall).
Cladopora fischeri (Billings).
C. roemeri (Billings).
C. *species.*
Crepidophyllum archiaci (Billings).
C. subcaespitosum (Nicholson).
Cyathophyllum gradatum Hall.
C. houghtoni Rominger.
C. nanum Hall.
C. nepos Hall.
C. robustum Hall.
Cystiphyllum americanum Edwards and Haime.
C. conifolle Hall.
C. corrugatum Hall.
C. varians Hall.
Favosites arbuscula Hall.
F. argus Hall.
F. billingsi Rominger.
F. clausus Rominger.

F. emmonsi Rominger.
F. epidermatus Rominger.
F. hemisphericus Yandell and Shumard.
F. placenta Rominger.
F. tuberosus Rominger.
F. *species.*
Heliophyllum halli Edwards and Haime.
H. juvene (Rominger).
H. proliferum Hall.
H. reflexum Hall.
Michelinia stylopora (Eaton).
M. dividua Hall.
Monilopora antiqua Whiteaves.
Streptelasma rectum Hall.
S. ungula Hall.
Striatopora linnaeana Billings.
Stromatopora mammillata Nicholson.
Stromatoporella expansa (Hall and Whitfield).
S. granulata (Nicholson).
S. incrustans (Hall and Whitfield).
S. *species.*
Syringopora nobilis Billings.
S. *species.*
Trachypora elegantula Billings.
T. limbata (Eaton).
Zaphrentis ampla Hall.
Z. exigua (Billings).
Z. halli Edwards and Haime.
Z. simplex Hall.

ECHINODERMATA.

Pentremitidea *species.*
Thylacocrinus *species.*
Undetermined plate of Crinoid.

VERMES.

Autodetus lindstroemi Clarke.
Cornulites intermedius (Nicholson).
Spirorbis angulatus Hall.
S. arkonensis Nicholson.

MOLLUSCOIDEA—BRYOZOA.

Acanthoclema sulcatum Hall and Simpson.
Ascodictyon fusiforme Nicholson and Etheridge, Jr.

A. stellatum Nicholson and Etheridge, Jr.
Bactropora *species.*
Botryllopora socialis Nicholson.
Ceramella scidacea Hall.
Clonopora *species.*
Cystodictya incisurata (Hall).
C. tumulosa (Hall and Simpson).
Favicella tessellata (Hall and Simpson).
Fistulipora colliculata (Hall).
F. constricta (Hall).
F. cornuta (Hall and Simpson).
F. distensa (Hall).
F. eriensis Rominger.
F. foliacea (Hall).
F. huronensis (Nicholson).
F. imbricella (Hall).
F. interaspera Hall and Simpson.
F. subtrigona (Hall and Simpson).
F. triangularis (Hall).
F. trifaria Hall and Simpson.
F. vesiculata (Hall and Simpson).
F. *a number of undetermined species.*
Hederella canadensis (Nicholson).
H. cirrhosa Hall.
H. conferta (Hall).
H. filiformis (Nicholson).
H. magna Hall.
Heterotrypa barrandei (Nicholson).
H. moniliformis (Nicholson).
H. *species.*
Intrapora puteolata Hall.
Leptotrypa quadrangularis (Nicholson).
Lioclema decipiens (Hall).
L. digitatum (Hall).
L. involvens (Hall and Simpson).
L. minutum (Rominger).
L. multaculeatum (Hall).
L. occidens (Hall and Whitfield).
L. segregatum (Hall).
L. *species.*
Orthopora bispinulata (Hall).
O. subquadrata (Hall).
O. *species.*
Pinacotrypa bullata? (Hall and Simpson).

P. elegans (Rominger).
P. hemispherica (Hall).
P. operculata (Hall and Simpson).
P. proporoides (Nicholson).
P. pustulosa (Hall and Simpson).
P. scrobiculata (Hall).
P. stellata (Hall).
P. umbilicata (Hall).
P. unilinea (Hall and Simpson).
P. variopora (Hall).
Ptilopora *species*.
Streblotrypa hamiltonensis (Nicholson).
Taeniopora exigua Nicholson.

MOLLUSCOIDEA—BRACHIOPODA.

Ambocoelia umbonata (Conrad).
Athyris spiriferoides (Eaton).
Atrypa reticularis (Linnaeus).
Camarotoechia billingsi (Hall).
C. horsfordi (Hall).
C. sappho (Hall).
C. thedfordensis Whiteaves.
Chonetes coronatus (Conrad).
C. lepidus Hall.
C. scitulus Hall.
C. vicinus (Castelnau).
Cranaena romingeri (Hall).
Crania crenistriata Hall.
Craniella hamiltoniae (Hall).
Cryptonella planirostris Hall.
C. rectirostris Hall.
Cyclorhina nobilis (Hall).
Cyrtina hamiltonensis Hall.
C. hamiltonensis recta Hall.
Delthyris consobrina (D'Orbigny).
D. sculptilis Hall.
Eunella lincklaeni (Hall).
Leiorhynchus laura (Billings).
Lingula delia Hall.
L. ligea Hall.
Martinia subumbona (Hall).
Meristella barrisi Hall.
M. haskinsi Hall.
M. *species*.

Nucleospira concinna Hall.
Orthothetes chemungensis (Conrad).
Parazyga hirsuta (Hall).
Pentamerella pavilionensis (Hall).
Pholidops hamiltoniae Hall.
Pholidostrophia iowaensis (Owen).
Productella spinulicosta Hall.
Reticularia fimbriata (Conrad).
Rhipidomella idonea (Hall).
R. leucosia (Hall).
R. penelope (Hall).
R. vanuxemi (Hall).
Spirifer audaculus (Conrad).
S. audaculus macronotus Hall.
S. divaricatus Hall.
S. granulosus (Conrad).
S. marcyi Hall.
S. pennatus (Atwater)= S. mucronatus (Conrad).
S. tullius Hall.
Stropheodonta concava Hall.
S. demissa (Conrad).
S. inaequistriata (Conrad).
S. perplana (Conrad).
S. *species.*
Trematospira gibbosa Hall.
Tropidoleptus carinatus (Conrad).
Vitulina pustulosa Hall.

MOLLUSCA—GASTROPODA.

Loxonema *species.*
Platyceras bucculentum Hall.
P. carinatum Hall.
P. dumosum rarispinum Hall.
P. symmetricum Hall.
P. thetis Hall.
P. *species.*
Platyostoma lineatum Conrad.
P. turbinatum Hall.
P. unisulcatum Conrad.

MOLLUSCA—CEPHALOPODA.

Goniatites uniangularis Conrad.
Orthoceras subulatum Hall.

MOLLUSCA—PTEROPODA.

Conularia undulata? Hall.
Hyolithes *species.*

CRUSTACEA.

Beyrichia *species.*
Phacops rana (Green).
Strepula *species.*

Notes on the Winter Habits of the Red-Headed Woodpecker.

H. A. WINKENWERDER.

The red-headed woodpecker is ordinarily a migrant. Its winter range in the Mississippi Valley, according to Prof. W. W. Cooke, is much restricted, although it is abundant as far north as the bottom lands of southern Illinois (1). He feeds upon both animal and vegetable matter in nearly equal quantities, the percentage varying according to season and locality. In the spring its food consists mostly of insects. "In the fall," says Capt. Chas. Bendire, "its diet is more largely vegetable, one of its staples being beechnuts; the berries of sour gum, dog wood, and palmetto are also largely eaten; acorns and Indian corn and small grain are likewise used, and it is well known that these birds store away supplies, consisting both of insects and vegetable matter, for winter use (2).

A remarkable case of the storing of insects is the one reported by Dr. G. S. Agersburg of Vermillion, S. Dakota, and it is probably he who was the first to report this habit of storing. He writes as follows:

"Last spring in opening a good many birds of this species with the object of ascertaining their principal food, I found in their stomachs nothing but young grasshoppers. One of them, which had its headquarters near my house, was observed making frequent visits to an old oak post, and on examining it I found a large crack where the woodpecker had inserted about 100 grasshoppers of all sizes (for future use, as later observation proved), which were put in without killing them, but they were so firmly wedged in the crack that they in vain tried to get free. I told this to a couple of farmers, and found that they had also seen the same thing, and showed me posts which were used for the same purpose. Later in the season the woodpecker whose station was near my house commenced to use his stores, and today (February 10) there are only a few shriveled-up grasshoppers left" (3).

Dr. C. Hart Merriam has noted many cases of the red-head wintering far to the north of its winter home when the food supply was abundant. From his extended observations he has drawn the conslusion that a good year for beechnuts means a good year for red-heads and squirrels. He found them wintering as far north as Connecticut and the northeastern portions of New York.

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(1) W. W. Cooke, Migration in the Miss. Valley, U. S. Agr. Rep. 1888, page 180.

(2) Capt. C. A. Bendire, Life Histories of N. A. Birds, p. 108, vol. II.

(3) Bull. Nutt. Ornith. Club, pp. 194, 195, from Beal Food of Woodpeckers, U. S. Dept. of Agr. Bull. No. 7, Div. Ornith. and Mammalogy.

In November 1899, Dr. O. G. Libby called my attention to the fact that red-heads were storing acorns in the vicinity of Madison, Wis., by inserting them between the cork ridges of our larger oaks (Quercus). Investigation soon showed that these birds were busy with this task in nearly every oak grove about Madison. Before winter had fairly set in a great many trees were well stocked with acorns, some containing hundreds of them. They were also found below the loose bark on old trees, in cracks in fences, in old posts, and in decayed wood. From a fence post which was split across the top and hollowed out I removed more than a pint of the nuts. Whenever the whole nut could be placed in a crevice conveniently this was done, but where the crevice was too narrow they were split in halves. This was very often the case. Nowhere, however, did I find them still in the cup.

Thinking the birds might have stored these acorns for the grubs they would yield I examined a large number, but no grubs were found. The half acorns, too, were in good condition, apparently as well preserved as the others.

Close watch was kept up all winter. One grove just west of the city seemed a favorable spot for the birds, and since it is only a short distance from the street railway line offered a convenient place for observation. It lies upon the western slope of a considerable hill (University Heights), and contains about two acres of healthy oaks (mostly Quercus alba and coccinea) interspersed with a few dead trees.

This place was visited about once every week for the entire winter. On bright sunny days the cries and rappings of these birds could be heard for some distance around. They flew about chasing each other as if engaged in play; sometimes as many as four or five occupied the same tree scolding in most excited tones; then again they could be seen hopping up and down the tree trunk, stopping now and then to rap upon the wood as if they enjoyed the drumming sound. Thus they would turn from one diversion to another, cheery and apparently well contented with the way nature treated them. But in severe weather they were not so lively. When the weather was intensely cold, although they were stirring, the jubilant spirit was absent. They made very little noise, and kept close to the tree trunks. I visited the place several times during stormy weather and then it was rare to see or even hear a single specimen. From the excretions in and about several holes in trees I concluded that these were the places they used for shelter during inclement weather, as also during the night, although I failed to drive out any by pounding these trees with a heavy club.

As the winter wore on the store of food gradually disappeared, until the end of February, when it was about exhausted. At this time, too, the birds began to scatter, the number in the grove decreased, and they were soon heard tapping upon the telephone posts about town. But many of the trees still bore evidences of the services they rendered during the past winter. In most cases the pulpy matter had been eaten out of the acorns without removing them, leaving a hollow shell as a mark in the corky bark of the tree. When they were not so firmly secured the remains were generally found in coarse, but more often finely broken parts at the base of the tree.

Upon further investigation by means of printed inquiries sent throughout the state, the red-headed woodpecker was reported from all but the extreme northern portions. The results as a whole were surprising. Of the one hundred and fifty blanks that were mailed about one hundred were returned, and the majority of these were intelligently answered. Still the greatest care must be exercised in the use of these reports. Such cases as seemed doubtful were either corroborated or discarded. Thus some of the reports from the northern tier of counties proved to have reference to the piliated woodpecker (*Ceophloeus*). In such cases where the birds were reported as present, but not the acorns, I have assumed that either the acorns were overlooked, or, as is the case in some reports, they came from localities where Quercus is scarce. All cases in which both the birds and acorns were reported were regarded as correct, but where only the acorns were reported considerable care is necessary. Thus Mr. B. H. Smith of Rock county writes that he saw blue jays storing the acorns; Mr. J. P. Lewis of Friendship, Adams county, says he saw the blue jay eat them; and Mr. Herbert Vaughn of Bowers, Walworth county, reports that the nuts were stored by the large spotted woodpecker (Dryobates villosus, in all probability).

With these facts and doubts before the reader he will be able to take the following results for what they are worth.

Many of the reports were exceptionally good and showed that much interest is taken in our Wisconsin birds. The results obtained should give us a fair conception of the distribution of Melanerpes in our state during the winter of 1899-1900. As the accompanying tabulation will readily show, the distribution seems to have been confined to certain areas, in some of which they were exceptionally numerous, in others less so. About Madison they were seen in large numbers. So, too, in the neighborhood of Beaver Dam, Dodge county. Mr. W. E. Snyder writes from that place as follows: "I could show you two dozen *any day* all winter long, *within city limits,*" and with reference to stored acorns, "Every tract of woods contains some of them." From Grant county they were reported very numerous, burying the acorns from one to two inches into the body of dead poplars.

In the northern section of the state, north of the 45th parallel, the red-head was comparatively scarce, excepting in Polk county. This, too, is the only place so far north from which stored acorns were reported, which is not at all remarkable, because Polk county is fairly supplied with oak.

From the remainder of the state we may separate the following three areas in which the red-headed woodpecker was abundant during the winter of 1899-1900. One of these lies in the northwestern portion, including Eau Claire, Pierce, Pepin, Clark and Dunn counties; another in the southwestern corner, including Grant, Iowa and La Fayette counties; the third lies fairly within the central portion of the state, including, beside Dane and Dodge counties, those bordering on Waushara. Whether or not this distribution coincides with that of Quercus in our state I cannot say. For the detailed distribution I have appended a tabulation of the results of my investigation.

Before concluding I should like to call attention to the biological significance of the storing habit of Melanerpes. On the one hand it should show the powers of a migratory species to adapt itself to a cold and wintery climate; on the other, the extreme importance of food over temperature as a cause for migration. These questions, however, must be attacked from the standpoint of the kind of food a bird eats, together with its method of obtaining it. It is just this which enables the red-head and all our resident birds to remain here over winter.

LOCALITY.		Were Red-headed Wood-peckers Seen?	Number of Birds Seen.	Were Acorns Stored.	Date of Report.
TOWN.	COUNTY.				
Ashland	Ashland	No	....	No	March 26
Marinette	Marinette	Yes	2	No	March 26
W. Denmark	Polk	Yes	4 or 5	Yes	March 31
Washburn	Bayfield	Yes	2	No	April 2
Merrill	Lincoln	No	....	No	March 26
Bailey's Harbor	Door	Yes	2	No	March 12
Egg Harbor	Door	No	....	No	Feb. 22
Forestville	Door	No	....	No	Feb. 21
Hammond	St. Croix	Yes	1	No	March 17
Woodville	St. Croix	No	....	No	Feb. 17
Menomonee	Dunn	Yes	2	No	March 7
Red Cedar	Dunn	Yes	5 or 6	No	Feb. 26
Wausau	Marathon	No	....	No	March 5
Ringle	Marathon	Yes	1	No	Feb. 26
Kelley Brook	Oconto	No	....	No	March 14
Shawano	Shawano	No	....	No	April 7
Shiocton	Outagamie	No	....	No	March 12
Appleton	Outagamie	No	....	No	March 10
Amherst	Portage	No	....	No	March 5
Grand Rapids	Wood	No	....	No	March 5
Grand Rapids	Wood	No	....	No	March 14
Rudolph	Wood	No	....	Yes	Feb. 20
Durand	Pepin	No	....	No	Feb. 17
Durand	Pepin	Yes	Few	Yes	March 21
Pepin	Pepin	Yes	8 or 10	No	March 19
Arkansaw	Pepin	No	....	No	March 23
Augusta	Eau Clair	Yes	6	Yes	March 11
Augusta	Eau Clair	Yes	6	No	March 12
Thorp	Clark	Yes	2	Yes	Feb. 20
Eidwold	Clark	Yes	....	Yes	Feb. 24
Winneconne	Winnebago	No	....	No	March 12
Pickett	Winnebago	Yes	5	Yes	March 16
Omro	Winnebago	No	....	No	March 8
Monroe	Green	No	....	No	March 19
Alma	Buffalo	No	....	No	March 21
Nelson	Buffalo	No	....	No	March 19
Waldo	Sheboygan	Yes	10	No	March 12
Elkhart	Sheboygan	No	....	No	March 11
West Salem	La Crosse	No	....	No	Feb. 24
Sparta	Monroe	No	....	No	March 7
Friendship	Adams	Yes	1	Yes	March 12
Manchester	Green Lake	Yes	8 or 10	No	March 5
Kingston	Green Lake	Yes	6	No	March 6
Necedah	Juneau	No	....	No	March 10
Forest Jct	Calumet	No	....	No	March 12
Liberty Bluff	Marquette	Yes	30	Yes	March 5
Packwaukee	Marquette	Yes	2	No	March 6

Four Mile	Fond du Lac	No	....	No	Feb. 20
Strum	Trempeleau	Yes	3 or 4	No	March 7
Galesville	Trempeleau	Yes	12	No	March 12
River Falls	Pierce	Yes	4	No	April 15
River Falls	Pierce	Yes	1	Yes	April 23
Algoma	Kewaunee	No	....	No	Feb. 23
Kodan	Kewaunee	No	....	No	Feb. 20
Nero	Manitowoc	No	....	Yes	March 5
East Gibson	Manitowoc	Yes	20	No	Feb. 20
Waupaca	Waupaca	Yes	200?	Yes	March 6
Marcellon	Columbia	No	....	No	March 6
Delton	Sauk	Yes	6	No	March 10
Wilmot	Kenosha	No	....	No	Feb. 15
Evansville	Rock	No	....	No	April 2
Tiffany	Rock	No	....	Yes	Feb. 6
Burlington	Racine	Yes	4	No	Feb. 20
Racine	Racine	No	....	No	Feb. 19
Benton	La Fayette	Yes	12	No	March 21
Shullsburg	La Fayette	No	....	No	March 24
Lancaster	Grant	Yes	50	No	March 11
Lancaster	Grant	Yes	many	Yes	....
Soldiers Grove	Crawford	Yes	1	No	March 6
Ft. Atkinson	Jefferson	No	....	No	March 5
Watertown	Jefferson	Yes	2	No	....
Bowers	Walworth	No	....	Yes	March 5
Beaver Dam	Dodge	Yes	24	Yes	Feb. 26
Fredonia	Ozaukee	Yes	4	No	Feb. 28
Hillside	Iowa	Yes	10	Yes	....
Madison	Dane	Yes	20	Yes	....

Place-Modes of Acris Gryllus for Madison, Wis.

By P. H. DERNEHL.

The purpose of this paper is to describe the Madison form unit of the cricket frog *Acris gryllus var. crepitans* (Le Conte) for comparisons with specimens from other localities and with future determinations of this form unit.

The frogs employed for study in the preparation of this paper were taken October 18, 1901, in Dane county, Wisconsin, along the banks of an artificial lagoon, fed by Lake Mendota, and near the Catfish river.

Along the banks of this artificial stream the frogs were extremely numerous, making it a comparatively small task to secure the one hundred specimens from which my tabulated results were obtained.

The frogs were collected at random.

DESCRIPTION OF THE FORM-UNIT.

The eyes are comparatively large and prominent, their posterior angles being slightly anterior to the angles of the mouth. (See Fig. I.) The snout is extended, and projects beyond the lower lip. (See Fig. I.) From about its middle point the body tapers gradually towards the snout with no contraction for the neck. (See Plate.) The external nares are small and more anterior than the eye, and each is placed upon a slight eminence, the canthus rostralis. The tongue is broadly oval, slightly or not at all notched (See Fig. II.) ; individuals having their tongue not notched predominating in numbers. It is free for about one-fourth or a little less of its length from behind, and is also free at the sides.

The tympanum is very small, in some individuals barely noticeable.

The inner nares are decidedly larger than the external nares.

The vomerine teeth are situated in two oval patches slightly larger than the internal nares, and are placed between these, their slightly longer axis inclined to each other posteriorly. Their posterior borders are in about the same transverse line with those of the inner nares, and they extend a little beyond anteriorly. (See Fig. II.) In this respect the frogs differed decidedly from the individuals described by Cope, who describes the position of these teeth thus: "The vomerine teeth are situated in two oval patches about the size of the nares, the slightly longer axis inclined a little to each other backward. They are placed between the nares, their anterior edges nearly in the same transverse line with those of the nares and extending a little beyond the nares posteriorly." It will be noted that the position of the vomerines is remarkably anterior as compared with other of our small American hyloids.

The openings of the Eustachian tubes are very minute.

The gular fold is well developed.

Quantitative data were taken for a number of characteristics selected either because (1) they were apparently variable here, or (2) known to vary throughout its range, these characteristics being known to me because given as diagnostic between the two subspecies into which the northern and southern forms have been grouped.

METHODS.

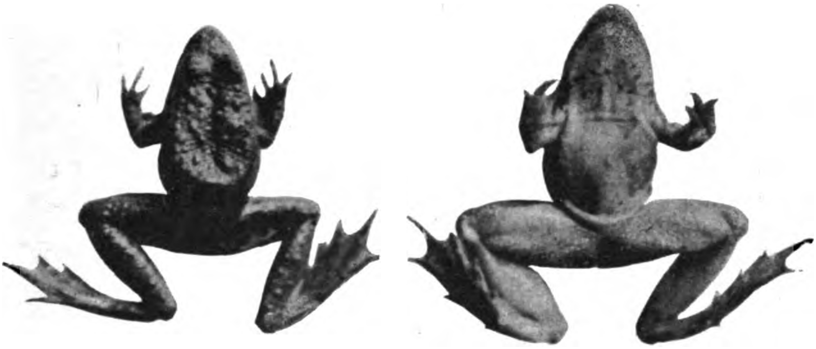
The measurements were taken in m. m. in most cases, but in one-half and one-tenth m. m. in the smaller measurements.

The measurements were recorded as falling into the classes 4-4.99 m. m., etc., or 4-4.09, etc., as the case might be. These measurements were then converted into per cent of total lengths by means of Zimmerman's Calculating Tables. The middle value of the two classes concerned being used as 24.5 divided by 28.5. The percentages were grouped in the same way as the original measurements. In some cases, where certain fractions not involving the total length had been used by systematists in describing this species or its subspecies, these percentages were also determined and seriated.

Where the resulting polygons were irregular owing to the use of too many classes for the number of individuals, they were grouped into larger classes, as few as possible being brought together to make the new classes. Of the several possible limits those were chosen which approached most nearly the theoretical curve, the sex and total length being known for each measurement. The extreme classes of each polygon were examined to find if any correlation existed between sex or age and any of the characteristics examined. This confessedly crude method revealed none except between sex and length.

MEASUREMENTS.

Length.—I found the length to vary from 20 m. m. to 30 m. m., the mode being 25-26 m. m. The dotted lines in polygon A represent the polygon for males, from which it is seen that the males are shorter than the females.



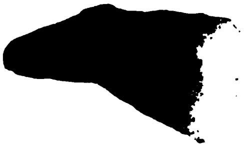


FIG. I

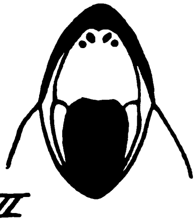


FIG. II

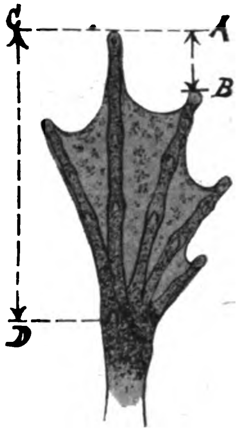
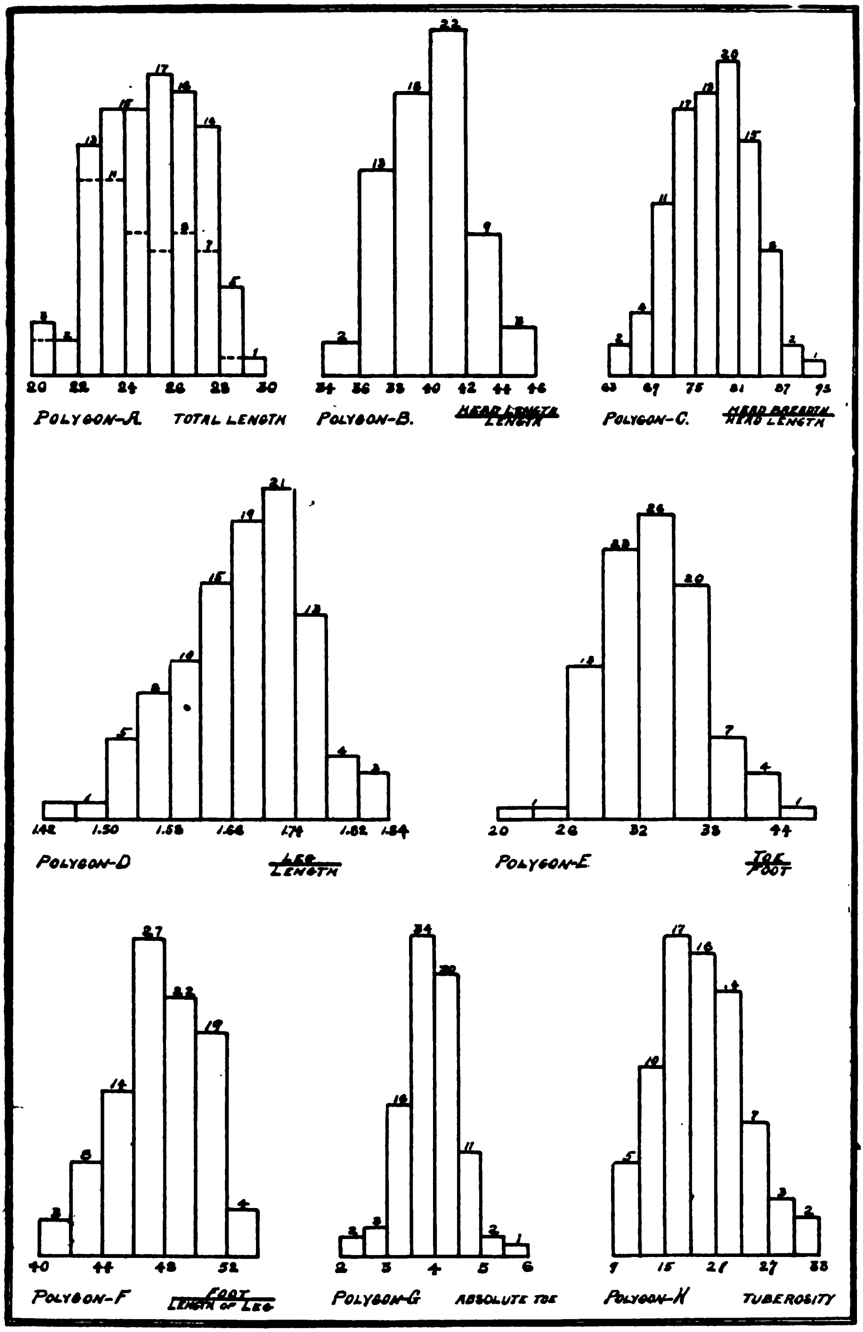


FIG. III

ACRIS GRYLLUS VAR. CREPITANS.



PLACE MODES OF ACRIS GRYLLUS.

The head, measured from the gular fold to tip of snout, varied from 8 m. m. to 11.7 m. m.; reduced to per cent of total length the mode became 40 per cent to 42 per cent, with a range from 34 per cent to 46 per cent. (See Poly. B.)

The breadth of head was measured across posterior edge of the tympanums and was seriated in terms of head length and varied from 6.2 m. m. to 8.8 m. m., and gave the mode of 78 per cent to 81 per cent, with a range from 63 per cent to 93 per cent. (See Poly. C.)

The leg was measured from the granule beneath the vent to the tip of farthest projecting toe. It varied in length from 30 m. m. to 51 m. m. Divided by the total length the mode became 1.70 to 1.74, with a range of from 1.42 to 1.84. (See Poly. D.)

The tibia is longer than the femur, and the femur somewhat longer than the foot.

The foot is well developed. All the metatarsi are cleft to the base excepting the two outer ones which are united. The toes are webbed to the base of the disks, the membrane filling up most the space between them except on each side of the longest metatarsi where the membrane forms a narrow margin on the penultimate joint. On the exterior edge of the foot the membrane continues as a rudimentary one. (See Fig. III.) Beneath the articulations of the metatarsi are two large metatarsal tubercles, on the outer side of the tarsus are three or four well developed subarticular tubercles. The foot was measured and seriated in terms of leg length, from the large metatarsal tubercle to the tip of the longest toe. (See Fig. III. C-D.), and was found to vary from 8 m. m. to 14 m. m., thus giving a range from 40 per cent to 54 per cent, with a mode of 46 per cent to 48 per cent. (See Poly. F.)

The projection of the second toe beyond the third (See Fig. III a-b), was found to vary from 2 m. m. to 5 m. m., with a range from 1.5 per cent to 6 per cent, giving a mode of 35 per cent to 40 per cent. (See Poly. G.) It was also seriated in terms of length of foot and varied from 20 per cent to 47 per cent, with a mode of 32 per cent to 35 per cent. (See Poly. E.)

The hands, like the feet, are well developed, though without webs. The fingers are provided with slightly enlarged convex disks, thus enabling the creatures to climb upon smooth perpendicular surfaces. The disks are traversed by a slight groove. The inner finger is caudal to the rest, and is provided with a soft and prominent tubercle at its base. Separated from this tubercle by a narrow interval is another tubercle of about equal size.

COLOR.

The color of this species is extremely variable. Usually the upper surface has a ground color of ashy gray with a faint greenish hue or brown. The whole upper surface of body and limbs is more or less overrun with small scattered elongate or rounded warts of irregular size. The back is covered with a varying number of black spots, all generally margined with lighter. Between the eyes is a triangle nearly equilateral, its sides slightly concave, and its base connecting the edges of the upper eyelids. This triangle is relatively constant and characteristic, though so pale and indistinct in some as to be barely discernible.

The upper jaw is black or dark brown, with four vertical pale lines on each side. From the eye to arm is a pale white line, usually quite easily seen. Dorsal to this line extending nearly to the insertion of the fore leg is an elongate black mark, and beneath the line is another running parallel to the posterior one and extending from the sides of the lower jaw to the lower part of the insertion of the arm. Posterior to the insertion of the arm is a large dark oblique white margined spot on the side of the body. Posterior to this, and more dorsal, is another black spot, also margined with white and running obliquely backward.

The median dorsal part is frequently occupied by a longitudinal red or green band, these bands being frequently bordered on either side by obscure black spots. The green and red bands are, where present, extremely variable from a pale inconspicuous green or red line to a prominent and distinct band of either color. Very rarely are both the green and red color present in the same individual. In the one hundred specimens examined I found but one case. The bands of red or green are either continuous or interrupted. Where very pronounced the band is generally continuous, and when not is generally interrupted. The colors have apparently no correlation with sex or age, as the table will illustrate. The one hundred individuals studied offered thirty-five individuals in which the colored bands were present.

RED			GREEN		
LITTLE	MEDIUM	MUCH	LITTLE	MEDIUM	MUCH
♂ 27 m. m.	♀ 27 m. m.	♀ 25 m. m.	♂ 27 m. m.	♀ 26 m. m.	♂ 25 m. m.
♀ 25 m. m.	♂ 25 m. m.	♀ 21 m. m.	♀ 24 m. m.		♂ 23 m. m.
♀ 27 m. m.	♂ 22 m. m.	♂ 27 m. m.	♀ 24 m. m.		♀ 28 m. m.
♂ 23 m. m.		♂ 23 m. m.	♀ 24 m. m.		♀ 23 m. m.
♂ 24 m. m.		♂ 24 m. m.	♂ 26 m. m.		♂ 27 m. m.
♀ 26 m. m.		♂ 24 m. m.	♂ 27 m. m.		
♀ 25 m. m.		♂ 25 m. m.			
♂ 24 m. m.		♂ 24 m. m.			
		♂ 22 m. m.			
		♂ 22 m. m.			
		♂ 23 m. m.			
		♂ 23 m. m.			
8	3	12	6	1	5

Beneath the color is ashy white; at times very pale yellow on the throat. The throat is generally more or less speckled with dusky or brown. (See Plate.)

The lower jaw is pale or exhibits a few dark specks at the symphysis. The ventral surface of the arm shows no black blotches, and the thigh, leg and tarsus are also destitute of black markings ventrally, though posteriorly two or three transverse ones.

A black spot is frequently visible over the vent, and a dark bar either continuous or interrupted passes along the posterior thigh as a femoral stripe.

Tuberosity: As stated, the dorsal part of the frog is more or less covered with warty elevations. Within the dark triangle on the head which was taken as an index for the general tuberosity the elevations varied from 9 to 32 (excluding one of fifty), with a mode of 15-18. (Poly. H.)

The lower parts are covered by depressed granulations extending half way up the side, and on the inferior face of the thigh. Two large granules are conspicuous beneath the vent.

Color Changes: The rapid color changes attributed to these frogs by various authors as Dr. Hay, Cope and Le Conte were not observed in individuals which we had in confinement in the laboratory for some time, the only noticeable change being a fading or increase of the ground color, the bands of green or red remaining permanent.

In formalin preservative the color fades into a dark ashy gray, the green bands disappear and assume the normal ground color, or can be distinguished as a darker band. The red bands do not undergo this change, or only to a slight degree, in either case, however, the bright luster of the living animal is entirely lost.

SUMMARY AND CONCLUSIONS.

I. The form unit of Acris gryllus v. crepitans for Madison, Wisconsin, has been described.

II. Quantitative determinations from one hundred individuals have been made of a number of characters and seriated.

III. The variation of color of the back and of the number of tuberosities has been found to be very great.

IV. The males are smaller than the females.

PLACE-MODES.

The determination of place-modes has for its object the investigation of evolution by exact quantitative methods. It results in fixing the conditions of a species in a particular locality at a particular time, thus giving a basis upon which to determine any change which that same species may undergo in the same locality after a definite lapse of time. The changes which a species may undergo in a relatively small number of years under ordinary conditions of environment are not sufficient to be detected in cases where descriptions are qualitative only or based upon a few individuals, but where a large number of individuals, taken at random, are measured the modes may be used as standards for reference.

Aided by such determinations, we can know the rate and direction of any change which a species may undergo, so that we may draw more definite conclusions concerning the causes of specific change. The comparison of place-modes throughout the range of the species has yielded important results. To quote Dr. C. B. Davenport: "The establishments of these place-modes for various species in various localities is the first *sure* step towards the solution of the problem of the Origin of Species."

Work of this nature is suggested for those who desire to make actual contributions to our knowledge of botany or zoology and yet lack the facilities or knowledge necessary for original contributions to the structure or relations of species.

The following classes seem especially favorable for study because of size, variability, ease of collecting, and, in many cases, of the presence of serial structures, which may be counted—reptiles, batrachians, fishes, decapods and myriapods. In plants the flowers and leaves offer numerous opportunities.

This work was undertaken in response to the appeal of Dr. C. B. Davenport for the quantitative study of variable species for the purpose of throwing light on the origin of species. I would call attention of the members of naturalists' field clubs to the articles by Dr. Davenport in the bibliography. This work is particularly adapted to these clubs in our large cities. The valuable enthusiasm of many young naturalists in these clubs is being satisfied by the almost useless task of searching for new stations for rare species.

In conclusion I wish to express my thanks to Mr. R. H. Johnson, to whom I owe the interest which stimulated me to the preparation of this paper and by whose kind advice and assistance the work was greatly facilitated.

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The Paddle Fish (Polyodon Spathula).

By HORACE BEACH, Sr.

This fish attracted my attention some forty years since on account of its odd and unusual form. Barton W. Everman, United States Ichthyologist, writes me that "this species was first named by Walbaum in 1792, *Squalus spathula;* later in 1801 Bloch and Schneider called it *Polyodon folium*, thinking it was a new species, but as the fish of Bloch and Schneider and that of Walbaum are specifically identical and as Walbaum's is the older name it must be accepted for the species. The fish is not a Squalus as thought by Walbaum, but belongs to the genus Polyodon, the correct Latin name is *Polyodon spathula* and not *Polyodon folium,* as you see in some books.

The *Polyodon spathula* belongs to the family of Polyodontidae, and "is found in the Mississippi and the Ohio, and their tributaries, in Lake Erie and in southern waters." It is a naked cartilaginous fish, its skin in color and appearance somewhat resembling the catfish. Its common name in different localities is paddle fish, spoonbill cat, shovel-nosed sturgeon, etc. It is edible, its flesh being white and savory. The fishermen cut off the head and tail and sell it for "boneless cat." Everman informs me that the roe makes good cavier. The mature fish is from 4 to 5 feet in length. I have seen them over 4 feet. Jacob Scrogum, a reliable fisherman, told me that he once caught one that was 5 feet in length. The smallest caught are from 10 to 12 inches in length and have an abundance of sharp needle like teeth, whereas the mature fish is toothless. This would seem to indicate that the small fish have a different method of obtaininig their food from the mature fish. It has a heterocercal tail, a symmetrical body from the tail to the head, which seems abnormally large, a toothless mouth capable of opening very wide, a slender under jaw, and very long gill-covers extending backward from the gill openings over the smooth naked skin, and capable of being closed water tight. It has ample gill-rakes, small eyes located well forward and low down, and two blow holes located back of the junction of the paddle. The paddle or spatula is a little more than one-fourth the whole length of the fish. It is composed of a beautiful network of cartilaginous bones which are covered with a stout skin. The fish subsists in part if not wholly on confervae, consisting of a tubular water plant which grows in great abundance on or near the surface of the water. I have formed a theory as to the manner in which the fish manages to collect and swallow its food. This theory is somewhat conjectural but to my mind seems reasonable. The fish elevates its paddle above the water and swims into the water plant, manipulating and guiding the water plant into its mouth; this would cause a current of water containing the food to pass out at the gill openings, while the gill-rakes would catch and hold the food. The eyes are admirably placed to see and control the movements of the fish. After a proper amount of confervae is thus caught the long gill-cover and mouth are closed, a compression of the cavity back of the gill-rakes would force the water forward and out of the blow holes and thus release the water plant from the gill-rakes, and a further compression of the mouth would press out the remaining water and leave the food in a fit condition to be swallowed without an undue amount of water. I once saw this fish swimming with its paddle raised above the surface of the water but had no conception at that time that it was collecting food, in fact did not know what it subsisted upon. Fishermen have told me that they have seen worms in their stomachs mixed with confervae, but I am of the opinion the fish is a vegetarian, as I know they have parasitic worms in their stomachs, of which I will say more later on. I thought if they are vegetarians that they must hybernate in the winter; as there is then no vegetation for them to live upon. Acting upon this impression I visited the fishermen drawing seins under the ice. I opened the stomachs of a number of the fishes. The walls of the stomachs were thick and contracted, the cavity was very small and in no instance was there found a particle of food in them, only a little yellowish fluid and sometimes a lively knot of parasitic worms that seemed greatly disturbed at being exposed to the cold atmosphere. This fish while lying in the muddy bottom in a torpid state during the winter is often attacked by lampreys, sometimes having life literally sucked out of them or so nearly so as not to have vitality enough to recuperate when released from their icy prison. I have seen many of them lying on the shores in the spring with their bodies emaciated and covered by wounds made by the lampreys. I have often seen these fish after the water became warm jump out of the water and come down on their sides with a splash, probably to rid themselves of lampreys. There is one very remarkable fact that no one has ever seen, a very small fish of this species, at least this is true as far as any information I have been able to obtain. I have a standing offer of $5.00 to any one who will bring me one not over six inches long, thus far without any response.

φ. 8'/

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BULLETIN
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MILWAUKEE, WISCONSIN.

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A

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MILWAUKEE, WIS.

ORGANIZED MAY 6, 1857.

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Botany	E. Bruncken	Mineralogy	Louis Lotz

REGULAR MEETINGS.

(1) These are all held in the Society's lecture room in the Museum-Library Bldg., Milwaukee.

(2) Meetings of the combined sections take place on the 2nd Thursday of each Month, at 8 P. M.

(3) The Archeology and Numismatics sections meet on the 3rd Thursday of each Month.

(4) General Meetings are on the last Thursday of each Month except July and August.

(5) Meetings of the Archeologists and collectors of the State are to be held semi-annually under the direction of the Archeology section, for the purpose of furthering the cause of Wisconsin Archeology.

PUBLICATIONS.

(1) The "Bulletin of the Wisconsin Natural History Society"—a 64 page octavo publication issued quarterly. Editor, W. J. Bennetts.

(2) The "Wisconsin Archeologist," published by the Archeology section. Editor, C. E. Brown.

MEMBERSHIP DUES.

City Members, $3.00 per annum; Non-resident Members, $1.00 per annum; Life Members, one payment of fifty dollars.

APR 28 1902

BULLETIN
OF THE
WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 2, New Series. **APRIL, 1902.** **No. 2.**

Proceedings of the Wisconsin Natural History Society.

November 27, 1901, to February 27, 1902.

THURSDAY, NOV. 27, 1901.

The general meeting for November was held this day in the lecture room of the public museum. Twenty-eight persons were present and President Teller occupied the chair.

C. E. Brown read reports of 2 regular section meetings held earlier in the month and also of a meeting of the numismatic section held at the residence of Mr. Louis Lotz.

A communication from the Misses Lapham of Oconomowoc was then brought to the attention of those present, in which they offered to present to the society 2 natural history scrapbooks compiled about 40 years ago, by their father, Dr. Increase A. Lapham. On the motion of E. Bruncken the books were accepted, and the secretary instructed to convey the thanks of the society to the Misses Lapham.

The following were then elected to membership: John T. Reeder of Calumet, Mich., and Alison S. Grover of South Milwaukee. Rev. S. D. Peet of Chicago, and John G. Gregory of Milwaukee, were elected honorary members.

A paper on the "Distribution and Succession of Forest Trees in the vicinity of Milwaukee" was then read by Ernest Bruncken, Dr. S. Graenicher following with a paper entitled "Notes on some Species of Wasps occurring at the End of the Season." A paper on "The Winter Habits of the Red Headed Woodpecker," by H. A. Winkenwerder of Madison was read by the secretary.

THURSDAY, DEC. 26, 1901.

This meeting was held in the usual place with 31 persons present and Mr. Teller presiding.

The minutes of 2 section meetings were read by C. E. Brown, after which 8 new members were admitted into the society as follows: H. A. Winkenwerder, W. E. Snyder, H. A. Crosby, M. C. Long, E. Butts, Fisk H. Day, E. C. Perkins, and F. M. Benedict.

A paper by Horace Beach, Sr., of Prairie du Chien on the paddle fish *Palyodon spathula* was read by the secretary. The author stated that the fish was a vegetable feeder, living on confervae and other plant growths of the waters it frequented, and lying dormant in the mud at the bottom during the winter months.

This paper was followed by one by Adolf Biersach, who described the experiences of himself and companions during a collecting trip made into Nicaragua, C. A., during the early part of 1901. Mounted specimens of birds and animals met with during the trip were exhibited to illustrate the paper.

Rev. Stephen D. Peet of Chicago, who was present, then made a short address, briefly outlining the work he had done in investigating the mound systems of Wisconsin. He exhibited charts of several groups of mounds and gave his interpretation of their purpose and significance.

THURSDAY, JAN. 30, 1902.

This meeting was held in the usual place with 63 persons present.

After the usual reports of meetings had been read the following were elected to membership: J. M. S. McDonald, Oscar Buxbaum, G. P. Stickney, S. W. Faville, W. F. Crosby, L. S. Drew, D. Mc L. Miller, Hon. G. W. Wolf, John Gerend, and Charles Goessl, Miss Mary J. Lapham and Miss Julia A. Lapham were elected honorary members.

Prof. E. C. Case then began the lecture of the evening, which was entitled "Methods of Collecting, Preserving and Restoring the Remains of large extinct Vertebrates."

The principal feature of the lecture was the large number of excellent lantern illustrations accompanying it, many of them being from photographs taken by Mr. Case himself. The localities where such collecting was chiefly done were shown to be among the most desolate and barren ones on the continent, such as the Bad Lands of South Dakota, and the chalk deserts of Kansas. The methods of fitting out an expedition and of taking care of the fossil parts discovered were described, as also was the work of cleaning and mounting the parts after their arrival at the museum. The latter part of the lecture was devoted to the work that has been done in restoring and picturing these extinct animals as they appeared while living on this continent, many thousands of years ago.

THURSDAY, FEB. 27, 1902.

At this meeting C. E. Brown reported on 2 section meetings held respectively on the 13th and 20th of the month, and gave notice that there would be a meeting of the numismatic section on the evening of March 6.

Dr. G. W. Peckham, chairman of the library committee, then read the following proposition which the committee had laid before the executive board of the Public Museum:

Dec. 12, 1901.

To the Executive Committee of the Board of Trustees of the Public Museum:

GENTLEMEN—At a meeting of the Wisconsin Natural History Society held last month the society authorized the special committee to suggest the following terms upon which they would be willing to transfer to the Public Museum the collection of books and pamphlets now in the possession of the society as well as others that might come into its possession in the future.

1st. That the Museum utilize the publications of the society as a means for maintaining as far as practicable unbroken sets of the publications of the various scientific societies.

2d. That as far as possible, the gaps in the present sets be filled in.

3d. That they provide for the suitable cataloguing of the present collection and future additions to the same.

4th. That they make the library accessible to the members of the Natural History Society at such hours as the Museum may be open.

5th. That upon the order of the President or the Secretary of the Natural History Society the Museum loan to the members of the society papers or books belonging to the sets provided for in the above recommendations.

Very truly,
GEO. W. PECKHAM,
Chairman.

To this he stated the following answer had been received:

Dec. 19, 1901.

Dr. Geo. W. Peckham, Chairman Committee of Wisconsin Natural History Society.

DEAR SIR:—In response to your communication of December 12, in relation to the terms upon which the Wisconsin Natural History Society would be willing to transfer their books to the Public Museum, I wish to say that the propositions contained in your communication have been considered by the Board of Trustees, that they have been accepted and that they shall be complied with as soon as the Board of Trustees will be in position to make the proper arrangements. Yours truly,

CARL THAL,
Acting Secretary.

A report of progress was then read from Carl Thal, acting secretary of the Museum, who stated that as a result of their efforts to fill the gaps in the sets of the North American Scientific societies, 100 volumes and 525 pamphlets had been added to the library during the past 5 months.

C. E. Brown drew attention to the unsatisfactory and incomplete state of the by-laws of the society, and G. W. Peckham, E. Bruncken and Charles Doerflinger were appointed a committee for their revision.

The following were elected to membership: W. H. Elkey, Clara Gladys Jones, Richard Philipp, Carl Thal, John F. Fedlin, C. H. Kroeger, F. Krempel, Theo. Wiese, A. H. Lohman, Mrs. Charles H. Kartak.

Miss Harriet B. Merrill then read an interesting paper entitled "The Scientific Spirit." It was shown in detail how science and its methods dominate in nearly all domains of knowledge and civilized life. Literature, however, it was said, was an exception to the rule, as the personal element contained in it prevented our measuring it by the absolute standards of science.

Mr. W. E. Snyder of Beaver Dam, Wis., followed with a paper on the "Mammals of Dodge County, Wisconsin," mentioning 36 species and sub-species that had all—with 2 exceptions—come under his observation. A large collection of skins which Mr. Snyder had brought with him to illustrate his paper, and which represented all but the larger animals in his list, was examined with much interest by those present at the close of the meeting.

The attendance on this occasion was 29.

WILLIAM J. BENNETTS,
Recording Secretary.

Some Recent Observations on the Migration of Birds.

By H. A. WINKENWERDER.

(Preliminary Report).

The following paper is designed merely as a report of progress. During the fall of 1897 Dr. O. G. Libby called the attention of the writer to the excellent facilities the telescope offers for the study of bird migration, and during the summer of 1899 upon his advice the following work was undertaken. Although it was originally intended that the course of investigation should comprise several series of telescopic observations and such material as could be obtained from a season's observation at one of the largest lighthouses on our Great Lakes, the work has broadened considerably since then. Since much of value in the study of bird migration depends upon the migratory routes followed in these spring and fall flights, some little attention has been paid to this subject. Also the history of the study of migration, as well as discussions upon the origin and causes of these semi-annual journeys, have been included in this work. These phases of the subject are about completed, but it will be impracticable to treat them in this article.

It was intended that the entire work should be completed with the present writing, but, owing to the quantity of material collected and the pressure of other work, this has become impossible. Hence the present paper is merely a preliminary report, designed to call attention to the progress of the work and the methods of procedure.

Although two visits were made to Spectacle Reef lighthouse, near Mackinac, Mich.,* the weather proved unfavorable for the collection of data from this source both times.

TELESCOPIC OBSERVATIONS.

Telescopic observations were begun at the Washburn Observatory at Madison, Wisconsin, in the fall of 1899, but the real work did not commence until the spring of 1900. During the months of April and May of that year five good sets of observations were obtained. In the fall of the same year one set was obtained October 8. During the spring of 1900 interested persons from several of our western universities were asked to co-operate in the collection of data, and the result was excellent. The following directions were sent to all who expressed their willingness to assist:

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*The writer spent two weeks at Spectacle Reef during the falls of 1899 and 1900.

BIRD MIGRATION.

Directions for Observing with Telescope.

The Instrument.

Should be one with an objective ranging somewhere between 2 and 6 inches. The eye-piece should be supplied with 2, or if possible 4, hair-lines crossing in the center, thus dividing the field of vision into quadrants or octants.

Time of Observation.

Begin to observe as soon as the moon is high enough to come distinctly into the field of vision, and continue until morning.

To Begin the Observations.

Focus the telescope on the moon with the point of intersection of the hair-lines on the moon's center. Turn the eye-piece so that one of the lines lies parallel to the direction in which the moon is moving across the heaven. Now turn to your note paper. At the head of this write the date, locality, direction of wind, and weather in general. Just below this draw a circle, putting in the hair-lines as they appear through the telescope. Number them, beginning at the right hand side of the one you have placed parallel to the direction of the moon and continuing counter clock-wise. See figure below:

The Observations.

(It is a difficult task to observe and write out the observations at the same time, and, also, it will tire the eyes to look at the bright moon too long at one stretch. It is, therefore, advisable to have two observers so as to relieve each other every half hour or even every fifteen minutes, the one writing the observations while the other is observing).

The time should be divided into periods of fifteen minutes each, i. e. the observations should be made for periods of this length.

The following data should be noted with every bird that crosses the field of vision:

The number and approximate tenths (as indicated by the hair-lines) at which the bird enters and likewise at which it leaves the field of vision.

The speed at which it is flying—slow, fast, like a shot, etc., etc.

His approximate size as compared to Goldfinch (size 1), Robin (size 2), and Crow (size 3). If slightly smaller add—sign, if larger a + sign.

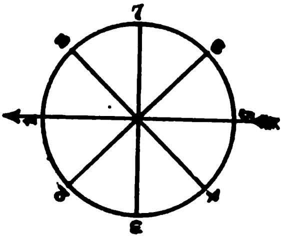
State if the bird is out of focus.

State if its wing-strokes are plainly seen.

Other remarks that you may think of value.

The notes should look like this:

Madison, Wis., May 14, 1900. Warm, with quite strong southwest wind; sky perfectly clear.



Period, 8:15—8:30.

I.	II.	III.	IV.	Remarks.
in.	out.	Speed.	Size.	....
..	...	.....	....	....
4.6	1.2	very slow	2	Small hawk soaring.
3.8	8.1	fast	1	Flight like goldfinch.
3.8	8.1	fast	1	Flight like goldfinch.
5.2	8.8	very fast	1	....
4.1	8.5	fast	2	Curved below center.

III. and IV. are of less importance than I. and II.

Note. If these directions are not clearly understood, or if you wish further information, write.

This resulted in eight excellent sets of data, and much credit is due Mr. Leon J. Cole of Ann Arbor, Faculty University of Michigan; Mr. H. S. Warren of Detroit, Secretary Michigan Ornithological Society; Mr. William James Rice, Faculty Lake Forest University; Mr. O. S. Dart, student University of Minnesota, and Mr. Wegemann, student Beloit College, and their assistants, for their hearty co-operation in the collection of these data. A set consisting of one evening's observations was contributed from each Ann Arbor, Detroit and Minneapolis; from Lake Forest there were two, and the writer, with the assistance of Mr.

Wegemann, obtained three at Beloit, while Dr. Libby conducted the observations at Madison. The data received from Michigan deserve special mention for the care with which they were collected.

One graphic representation illustrating tabulations of these data has been completed and will appear below. It is hoped that the other comparative tabulations will bring out points in the migration of birds hitherto unknown. Beside the observations mentioned above, Dr. Libby has recently turned over to the writer nine sets of data taken at Madison from April 9, 1898, to May 22, 1899, and three tabulations of data taken at Madison in the fall of 1897. This makes a total of 28 sets of data, comprising the observation of over fifteen hundred individual birds. Since these data were collected at various times during four years and in different localities they should yield good results.

It may appear to the inexperienced reader that little more than the direction of flight, the speed and size of a bird can be distinguished by this method. There are, however, many features brought out with the help of the telescope, which, although of little value when taken separately, reveal many points of interest when brought together in the form of tabulation. Furthermore, it is not of rare occurrence that a species can be identified.

The following tabulation will show in general something of what these data may yield:

BIRD MIGRATION AT DETROIT.

Being situated on a wide river between Lake Erie and Lake Huron, Detroit should offer good facilities for the study of migration. The following excellent summary of the observations taken at that place, together with the original data, was submitted by Mr. H. S. Warren:

Data on Nocturnal Bird Migration.

OBSERVATIONS TAKEN WITH THE TELESCOPE, WITH THE MOON FOR A FIELD OF VISION.

Detroit, Mich., May 13, 1900.

Meteorological Data: Atmosphere, fair; wind, light, southwest. Temperature: Max. 70 degrees at 8 p. m.; min. 66 degrees at 12 midnight.

Time, 8:15 p. m. to 12 midnight, divided into periods of 15 minutes each.

Number of birds seen from	8:15 to 8:30,	8.	
"	8:30 to 8:45,	7	
"	8:45 to 9:00,	10.	
"	9:00 to 9:15,	8.	First hour, 33
"	9:15 to 9:30,	9.	
"	9:30 to 9:45,	10.	
"	9:45 to 10:00,	14.	
"	10:00 to 10:15,	8.	Second h'r. 41
"	10:15 to 10:30,	10.	
"	10:30 to 10:45,	6.	
"	10:45 to 11:00,	4.	
"	11:00 to 11:15,	7.	Third h'r., 27
"	11:15 to 11:30,	4.	
"	11:30 to 11:45,	1.	
"	11:45 to 12:00,	5.	4th period, 1c

Total number seen from 8:15 to 12:00, 111.

DIRECTIONS OF FLIGHT.

Number of birds traveling Northeast	74
Number of birds traveling North-northeast	13
Number of birds traveling East-northeast	11
Number of birds traveling North	4
Number of birds traveling North-northwest	5
Number of birds traveling Northwest	3
Number of birds traveling Southeast	1

SPEED.

Nnmber of birds traveling very rapidly	75
Number of birds traveling moderately	22
Number of birds traveling slowly	12
Number of birds traveling very slowly	2

RELATIVE SIZES OF BIRDS.

Small (Goldfinch)	66
Medium (Robin)	27
Large (Crow)	15
Very large	3

IDENTIFICATIONS, ETC.

No. 12 (see original list) had the flight of a hawk or owl. No. 28 had wings spread like a hawk soaring. No. 31, wing motions were plainly seen, but no identification could be made on account of uncertain distance. No. 34 had wavy motion of flight, like goldfinch. No. 46 passed slowly, the wings beat rapidly and the neck was seen stretched out like a duck, loon, or grebe. The slow passage was evidently caused by distance. No. 61 had flight like goldfinch. No. 72, wing motions were plainly seen. No. 94 passed very slowly; this was evidently a large bird at long range, as it occupied three seconds in passing over the field and wing motions were plainly seen.

COURSES OF FLIGHT.

108 Birds kept their direct courses while passing over the field of vision.
1 Bird came in moving southeast and curved back to northeast, changing its course about 45 deg.
2 Birds flew in a curve; one changing its course from northeast to east and one from northeast to north.

The observations were taken at the Cartwright observatory located about three-fifths of a mile from the river. The telescope, a 6-inch refracting instrument, equatorially mounted, with an 8-inch focus, was at an average angle, during the period of observation, of about thirty degrees. If the birds that were traveling northeast, which numbered considerably more than half of all noted, were following the course of the Detroit River, which seemed evident, they must have been somewhat more than half a mile above the surface.

BIRD MIGRATION AT BELOIT AND MADISON.

The tabulations given below represent several periods of the original data from Beloit and Madison. They will serve to show a few of the points gained directly from observation. The telescope offers a means for watching nocturnal migrants during the time they are actually moving. Though we gain a view of only an infinitesimal portion of the vast migratory wave in so small a field of vision, enough is revealed to make it well worth the undertaking.

DATA FROM BELOIT.

BELOIT, WIS., May 12, 1900.

Period, 1:45—2:00.

In.	Out.	Speed.	Size.	Remarks.
...	...	.....	.	...
2.3	4.4	swift	1	...
1.6	4.9	swift	2	...
1.3	4.8	swift	2	same birds, rapidly succeeding each other.
1.3	4.7	swift	2	
1.	5.6	swift	2	...
8.	5.7		1+	...
8.9	6.		1+	...
2.3	5.4			...
2.8	4.8			...
2.	5.8	swift	2*—	...
2.	5.5			...
1.9	5.6			...
1.5	5.6			...
1.8	4.8			...
8.8	5.8			...
8.8	5.5		1	...
...	...			Birds are coming in bunches.
...	...			...
...	...			First bunch—Same birds, all flying about parallel to the line from 8.8—5.5, several in field at same time. Came too rapidly to note exact direction.
...	...			
...	...			
...	...			
...	...			
...	...			Second bunch.
...	...			...
...	...			...
...	...			...
1.8	5.8		2*—	...
2.	5.8			...
3.	8.3		1—	...
1.2	6.3		2*—	...
2.1	4.3	slow	2	...
1.2	6.		1	...
1.8	5.8		2	...
3.	6.3	swift		...
2.8	5.8		2	...
1.6	5.8			...

Total number of Birds, 35.

---

*Looked like same species.

DATA FROM MADISON.

MADISON, WIS., Apr. 18, 1900.

Period, 12:15—12:30.

In.	Out.	Speed.	Size.	Remarks.
...	...	.....	.	....
3.5	8.9	swift		Flew like a shot.
3.8	8.2			....
3.	8.9		3*	....
5.7	7.9			....
4.2	7.9			Out of focus.
...	...			Pause of five minutes of no birds.
...	...	.....	..	....
3.8	8.3	slow	1—	....
4.9	7.2	fast	3+	Out of focus.
5.8	7.1			Flight of goldfinch.
5.	2.1			....
4.2	8.2			....
5.	1.2			....
7.9	4.2			Sailed out of the field like a meadow lark.
4.	8.6	swift	1	....
3.9	8.5	slow	1	Flitting carelessly. He paused a second as if to turn in his course.

....

Total number of birds, 14.

CARTOGRAPHIC REPRESENTATIONS.

The cartographic representations into which the majority, if not all, of the data for this work will be placed are of two kinds. The first (See Plate I.) represents a graphic view illustrating the number of birds seen in periods of fifteen minutes each. Upon the assumption that the majority of nocturnal migrants commence their journey at about the hour of sundown, the eight sets of observations upon the accompanying plate were reduced to the same time after that hour. The data from which these graphs were drawn were collected from six different localities. It was hoped that they could all be obtained upon the same day, but this was nigh impossible.

It is remarkable to note the similarity in the rise and fall of some of these graphs, especially in the cases of Ann Arbor and Detroit. From the Madison and Beloit lines it would seem that

PLATE I.

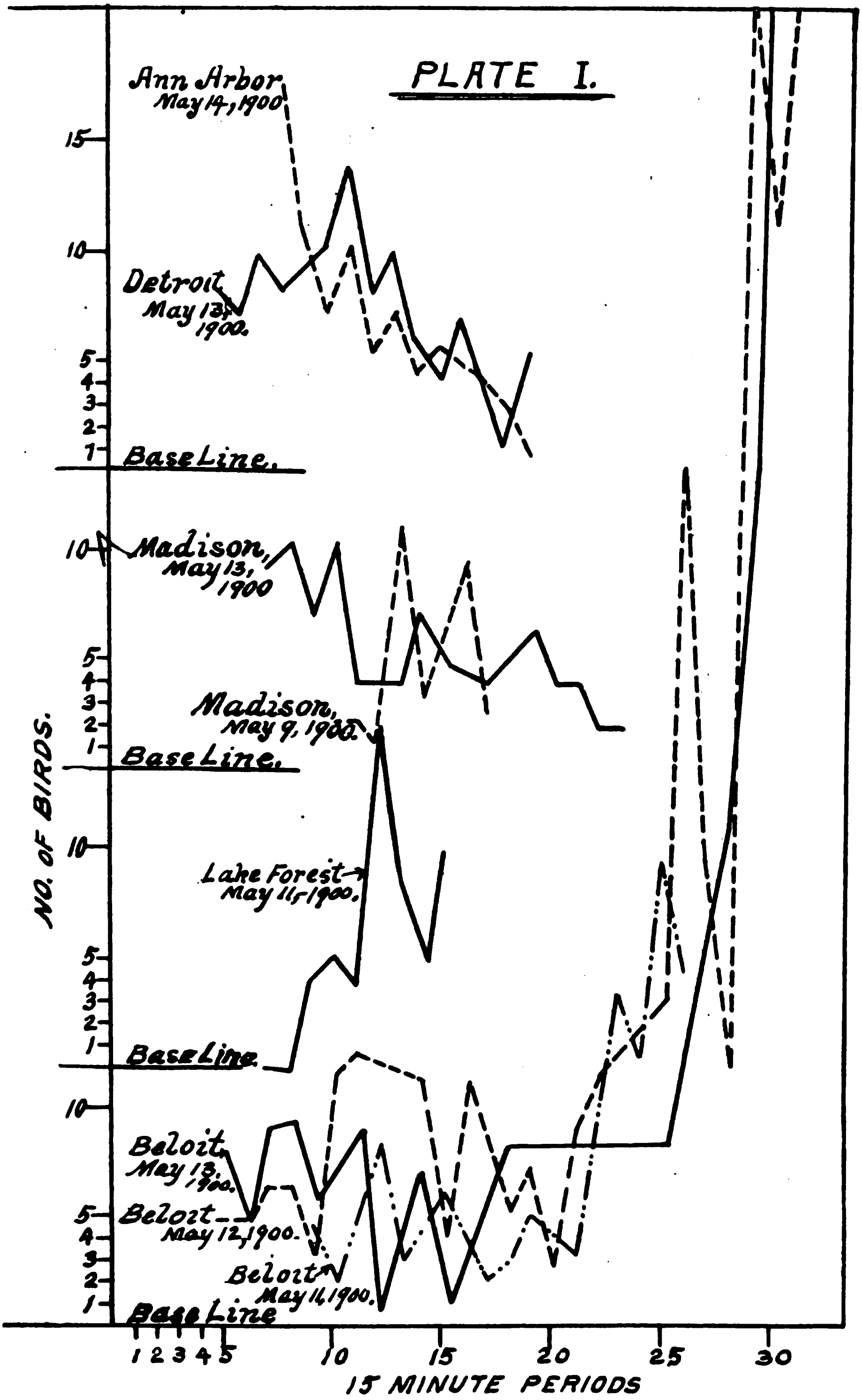
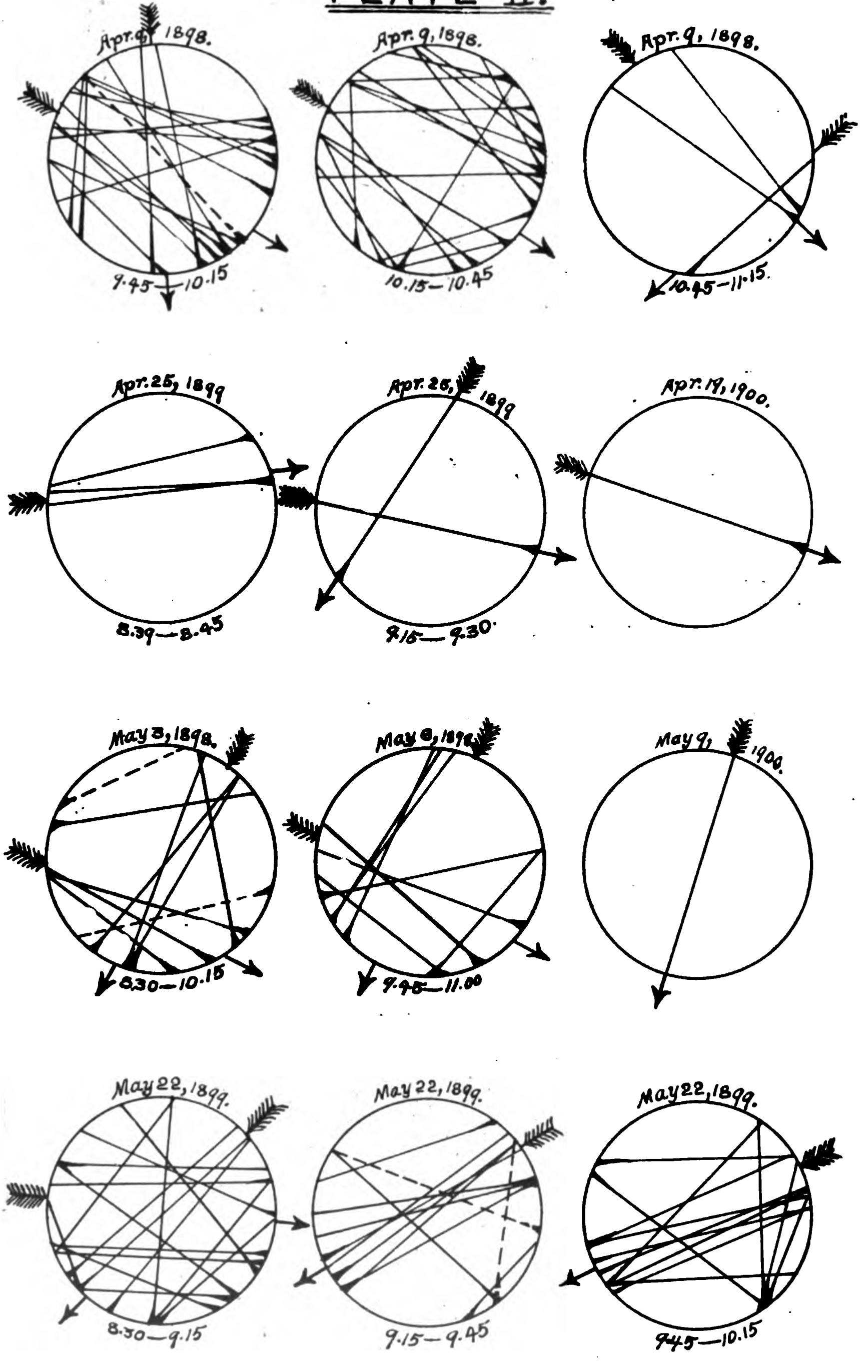

Ann Arbor
May 14, 1900
Detroit
May 13, 1900.
Base Line.
Madison,
May 13,
1900
Madison,
May 9, 1900.
Base Line.
Lake Forest
May 11, 1900.
Base Line
Beloit
May 13, 1900.
Beloit
May 12, 1900.
Beloit
May 11, 1900.
Base Line
15
10
5
4
3
2
1
NO. OF BIRDS.
1 2 3 4 5
10
15
20
25
30
15 MINUTE PERIODS

PLATE II.


Apr. 9, 1898.
9.45—10.15
Apr. 9, 1898.
10.15—10.45
Apr. 9, 1898.
10.45—11.15.
Apr. 25, 1899
8.39—8.45
Apr. 25, 1899
9.15—9.30.
Apr. 19, 1900.
May 3, 1898.
8.30—10.15
May 8, 1898
9.45—11.00
May 9, 1900.
May 22, 1899.
8.30—9.15
May 22, 1899.
9.15—9.45
May 22, 1899.
9.45—10.15

the topography of the surrounding country has much influence upon the number of birds flying. In each of the Beloit lines the sudden enormous rise of the lines marks the time when the telescope pointed directly down the course of the Rock River. In Madison the same feature is true. During four years of observation the greatest flights were obtained when the telescope pointed over the Madison Lakes and Yahara River system. The topography surrounding Lake Forest, Ann Arbor and Detroit, has not yet been studied sufficiently to enable us to say what the conditions are at these places.

Another form into which the observations will be placed is that illustrated by Plate II. We have here a number of circles each representing the field of vision during a certain period of time. Each line in the circle represents the flight of a bird, the lightly shaded end shows the place of entrance into the field of vision, the other the exit, and the dotted lines birds that were so close to the telescope that they appeared out of focus. The arrows outside of the circles show the general direction of flight for the period. This makes a most serviceable form into which to place these data.

One special feature noticeable on the accompanying plate (II.) is the two main directions of flight, with the predominance of the one in April and the other in May. This would seem to indicate two distinct migratory routes passing through Madison. Indeed other observations seem to indicate that this is actually the case.

It is not the object of this preliminary report to discuss generalizations. The foregoing considerations have been given merely to show the trend of the work and somthing of the results we may expect to attain from this method of observation. The telescope certainly offers an excellent field for research to the student of ornithology, and it is to be hoped that in the near future it may be brought into operation over a larger territory.

Brief Notes on Some of the Rarer Birds of Dodge Co., Wis.

By W. E. SNYDER, Beaver Dam, Wis.

It is not claimed by the author that the birds enumerated below are rare birds throughout the state—the list referring only to this county. To my knowledge some of these occur in considerable numbers elsewhere in Wisconsin. My observations date from Oct. 12, 1888.

LARUS PHILADELPHIA-BONAPART'S GULL.—A male was taken on the lake here in October, 1893, and 5 birds were brought to me the past fall—when they were quite common, in small flocks.

LARUS FRANKLINI—FRANKLIN'S ROSY GULL.—Two specimens —(Nos. 4526 and 4527, coll. of W. E. Snyder)—both taken on Sept. 18, 1901. They were in company and none others have been seen or taken to my knowledge. One was an ad ♀ with bright rosy plumage (No. 4526), the other an immature ♂.

STERNA TCHEGRAVA-CASPIAN TERN.—Two records—one taken Oct. 4, 1896—too badly decomposed when it came into my hands to sex or preserve—and one taken Oct. 5, 1900 (No. 3236, coll. of W. E. S.)

ANHINGA ANHINGA-ANHINGA.—Mr. Chatfield shot one here some 20 years ago. He described his bird to me and says he knows the Cormorant (P. dilpohus), and I am satisfied of its identity.

CLANGULA HYEMALIS — OLD SQUAW. — Five records — two taken at Fox Lake on Oct. 29, 1898; two taken there on Nov. 1, 1898, and I mounted one shot at the same place on Nov. 5, 1899. The first four were not sexed—as they were in the hands of a Milwaukee gunner who would not part with them—yet they were all ♀ ♀ or perhaps some immature ♂ ♂. They lacked the long tail feathers and black breasts of the adult. The fifth (No. 1853) proved on discussion to be a ♀.

ARDEA EGRETTA—AMERICAN EGRET.—Mr. George A. Morrison, once a taxidermist at Fox Lake, but now residing in Colorado, reports the capture of one at Randolph in May, 1895. It was mounted by Mr. Morrison. I did not see the bird, but presume the identification was correctly made, as Mr. Morrison was a painstaking student of birds.

PHALAROPUS LOBATUS—NORTHERN PHALAROPE.—Three were secured by Mr. Morrison and the writer at Fox Lake on Sept. 4, 1891. Two more were seen there the next day. These are my only records.

MICROPALAMA HIMANTOPUS—STILT SANDPIPER.—But one record a juv ♂ secured by me on this lake on Sept. 13, 1890. In an evil moment I disposed of it to a California collector, thinking I would be able to obtain more of them. Efforts to regain possession of the bird have proved futile.

TRINGA (PELIDNA) A-PACIFICA—RED-BACKED SANDPIPER.—Three records of capture—two on Oct. 4, 1901 (4578 and 4579) and one on Oct. 25, 1901 (No. 4653).

LIMOSA FEDOA—MARBLED GODWIT.—I have seen one of the two birds taken here some 20 years ago by Mr. Chatfield and verified his identity.

ECTOPISTES MIGRATORIUS—PASSENGER PIGEON.—Only two actual records of *capture* in 13 years—though I have seen them on several occasions—but not since about 1896. The last one taken was a juvenile, found dead on Downer College Compus at Fox Lake, by a Miss Brown, on Sept. 11, 1891.

ARENARIA MORINELLUS—TURNSTONE.—First and only record one seen by me on Aug. 18, 1901. It was in a high state of plumage.

COLINUS VIRGINIANUS—BOBWHITE.—Becoming more common each year. Flocks may be found at any time in certain localities. Hunters, spare the quail—as the sight of a few recalls days when they were common here.

CATHARTES AURA—TURKEY VULTURE.—Now and then seen. I have handled but two—one taken on May 18, 1894—an ad ♂ —and one taken Oct. 1, 1899—ad ♀. The former was poor in flesh, with great scabs on its feet—evidently a diseased bird.

BUTEO LINEATUS—RED-SHOULDERED HAWK.—But one taken —an immature ♂, shot by me on Sept. 15, 1900 (No. 3195, coll. W. E. S.)

STRIX PRATICOLA—AMERICAN BARN OWL.—One taken at Fox Lake in the winter of 1894 (Morrison) and Mr. W. R. Chatfield of this city took one here "many years ago." Mr. Chatfield was once a taxidermist and is a student of birds as well.

MELANERPES CAROLINUS—RED-BELLIED WOODPECKER.—Three records—one seen June 5, 1899; one Oct. 26, 1901, and one Nov.

16, 1901. The markings of this bird and their peculiar notes render their identity certain.

NUTTALORNIS (CONTOPUS) BOREALIS—OLIVE-SIDED FLYCATCHER.—Three records—a ♂ taken Aug. 12, 1896 (No. 209, coll. of W. E. S.), a ♀ taken September 15, 1901 (No. 4459, coll. of W. E. S.) and one seen on Sept. 11, 1901.

COCCOTHRAUSTES VESPERTINUS—EVENING GROSBEAK.—Occurs commonly some winters, feeding on the seeds of the box elder tree. None observed as yet this present winter.

PINACOLA ENUCLEATOR—PINE GROSBEAK.—Has occurred a few winters. One ♀ was taken near Loss Lake by Geo. J. Miller on Jan. 16, 1900. It was feeding *on the ground* in company with a large flock of Snowflakes (Passerina nivalis) on the edge of a tamarack swamp. It was the only one seen.

SPINUS PINUS—PINE SISKIN.—Erratic. Abundant from Sept. 25 to Dec. 30, 1896. Next seen the past fall—when it was common.

AMMODRAMUS HENSLOWI—HENSLOW'S SPARROW.—This bird is an abundant summer resident in the dryer marshes about Beaver Dam. Early morn and after sunset are its hours of song if song it can be called.

SPIZELLA PALLIDA—CLAY-COLORED SPARROW.—One record—a bird taken July 9, 1899 (No. 1430, coll. of W. E. S.)

ZONOTRICHIA QUERULA—HARRIS' SPARROW.—One record—*a* ♂ of the year, taken on Oct. 5, 1890. It was in company with a flock of Fox Sparrows (P. iliaca).

ZONOTRICHIA LEUCOPHRYS — WHITE-CROWNED SPARROW. — One was seen about eight miles southwest of Beaver Dam in the fall of 1896 (Exact date not accessible at this moment). It is my only record.

MELOSPIZA LINCOLNI—LINCOLN'S SPARROW.—Was quite common in the spring migrations of 1892 and at least two pairs bred But not seen again until the past season—when a few were seen—and one taken on Sept. 16 (No. 4476, coll. of W. E. S.).

AMPELIS GARRULUS—BOHEMIAN WAXWING.—Common nearly every winter. None seen thus far the present season.

VIREO SOLITARIUS—SOLITARY OR BLUE HEADED VIREO.—But one record—one captured on Sept. 24, 1901 (No. 4536, coll. of W. E. S.)

VIREO PHILADELPHICUS—PHILADELPHIA VIREO.—Two records—one seen in the spring of 1901 and one taken on Sept. 26, 1901 (No. 4561, coll. of W. E. S.).

HELMINTHOPHILA CHRYSOPTERA—GOLDEN-WINGED WARBLER.—Two records—a bird taken Aug. 14, 1901 (No. 4245) and one taken Sept. 10, 1901 (No. 4405).

DENDROICA CAERULEA—CERULEAN WARBLER.—One seen by me some 10 years ago, but have never seen it since.

HELMINTHOPHILA RUBRICAPILLA—NASHVILLE WARBLER.—I have long looked for this bird, but have so far taken but one—on Sept. 8, 1901 (No. 4399).

GEOTHLYPIS AGILIS—CONNECTICUT WARBLER.—First record—May 24, 1901 (No. 3962)—and during the great warbler waves of the past fall I saw many and captured several.

ICTERIA VIRENS—YELLOW-BREASTED CHAT.—One record—a pair taken by me on June 1, 1896. These birds were common in my old home in Illinois and I know their habits well and am sure they have never been met here on any other occasion.

A List, With Brief Notes, of the Mammals of Dodge Co., Wis.

By W. E. SNYDER, Beaver Dam, Wis.

Dodge County, situated in south central Wisconsin, its principal city Beaver Dam, being 65 miles distance from Milwaukee, is peculiarly adapted, by its geographical location and topographical features, to a large and varied fauna. Within its borders are found level fields, heavy hard-wood timber, tamarack swamps, hills of considerable elevation, willow thickets, large tracts of marshland, some flooded and some now dry, several lakes, some of which are bordered by upland pastures, elsewhere by extensive marshes, several small streams and *occasional* weedy, worthless tracts of stony hill sides. In these different areas are found congenial homes for numerous species of small mammals—particularly the Rodentia.

The following list embraces 36 species and sub. sp., all of which, except the otter and wildcat, have been actually observed by the writer. That other species occur within our country there can be no doubt. My personal labors have been practically limited to a field extending not further than 3 miles from my home, near Beaver Dam, and at Fox Lake, 10 miles north. Horicon marsh, with its thousands of acres and its surrounding bluffs, has never been explored. In the sandy regions about this marsh I am told that the Pouched Gopher (*Geomys bursarius*) occurs. And in a letter received from Dr. C. Hart Merriam of the Biological Survey, dated February 17, 1897, he writes that the Prairie Meadow Vale (*Microtus austerus*) and three or four species of Long-tailed Shrews (*Sorex hoyi, fumeus, richardsoni* and *personatus*) *should* occur here. We are also within the range of the Star-nosed Mole (*Condylura cristata*). But of these seven species only *Microtus austerus, Sorex richardsoni* and *Sorex personatus* have come under my observation.

All specimens of which there could be the least doubt of their identity have been named by Dr. Merriam of the Biological Survey and his assistants—and I here wish to extend my thanks to Drs. Merriam and Palmer and Mr. W. H. Osgood for their kindness and labors in my behalf.

In my list no particular order of classification is followed, the Rodentia being given first because they are the most numerous, in species as well as in individuals. The names used are those now used by the Biological Survey in their many excellent publications.

My observations date from October, 1888.

Spermophilus tridecemlineatus (Striped Spermophile).

This Rodent, known locally as "Gopher," is exceedingly abundant in our county. They frequent pastures, grain fields, roadsides—in fact anywhere except in the timber and flooded marshes. It is not uncommon to find them in dry marshes, even as far as half a mile from any solid earth. Their principal food is grains and grass. One killed on August 11, 1894, had 181 kernels of barley in its cheek pouches.

With us this species goes into hibernation from the first to 20th of October, varying as does the season—and appears again late in March or early in April—as soon as the frost is well out of the ground and the days have become sunny and warm.

Four and five appear to be the usual number of young, and when about one-third grown may be seen playing outside of their underground home. At this period they do not appear at all shy, and should one be surprised far from its home it runs about aimlessly as if lost.

Although they frequently burrow under grain shocks, throwing out considerable quantities of earth, yet seldom are they complained of as a destructive and detrimental animal.

When they first come forth from their winter homes they are shy and quiet. A few weeks of bright warm weather and their whistle may be heard at almost any hour of the day. The last ones seen in the fall are also very shy and quiet, as if ashamed to be seen abroad so late in the season. In the fall they forage from daylight till dark, and I have frequently seen them abroad long after sunset, even as darkness was falling.

The weather effects their habits to a considerable extent. Dark, gloomy days few will be seen, while on bright sunshiny days it sometimes appears as if every living one is about, so numerous are they then.

This species seldom has more than two openings to its underground home and often but one.

My friend, Delos Hatch of Oakfield, had a pure white individual as a pet during the summer of 1901.

On two occasions I have seen one-third grown young late in August, which tends to prove that the species does occasionally bring forth two litters in a year. On one occasion I observed one of these rodents to drag into its burrow a dead Garter Snake

(*Thamnophis*). This was at a time when food was plenty, therefore I am led to believe that this individual had a liking for this food.

Spermophilus franklini (Gray Gopher—Franklin's Spermophile).

Known generally as "Gray Gopher." From time to time it has been reported to me that these spermophiles are common in certain parts of Trenton and Burnett Townships, but lack of time has prevented me from making any investigations in those localities.

My personal records of this interesting species are three in number, as follows:

The first one, No. 1156 a ♀, was caught when running near the barns, on August 8, 1891.

The second one, No. 1157, also a ♀, was dug from its burrow in an oat field on August 11, 1892.

At both of these dates a thorough search of the farm failed to reveal signs of any more. These two were evidently stragglers.

The third one, No. 1700, a very large and exceedingly fat ♂ was discovered by my father, when en route to Fox Lake, running along the roadside on the Gutgesell farm, 4 miles north of my home. This was on May 22, 1900. On one side of the road was a field of newly sown grain, with a clover field on the other side. The animal ran about aimlessly, as if lost or undecided where to go, and though very adept in dodging its pursuer was finally despatched with a stick. Subsequent inquiry brought forth the claim by the proprietors of the land that they were seen there every year, but I visited the farm several times during 1900 and 1901 but saw no trace of the species.*

This spermophile, unlike the striped species, has several openings to its home, and honeycombs the soil for a considerable space, throwing out a large quantity of earth.

Tamias striatus griseus (Chipmunk.)

An abundant species, frequenting timber and along old rail fences, sometimes considerable distance from timber.

In September, 1899, I found it abundant on the high wooded shores of Fox Lake, frequenting the beaches, and having its home among the projecting roots of trees, on the bank and about old logs. Here it was feeding on the seed of the linden and on mollusca. In the cheek pounches of several which I shot were found numbers of the shell, *Planorbis campanulatus*, a species abundant at this place. Strange as it appeared to me, fully 75 per cent. of these were *dead* empty shells, from which the animal had decomposed. This would lead one to believe that it was the hard exterior covering and not the soft animal substance within, which the Chipmucks sought for food.

---

*This one weighed 15½ oz. and measured as follows:—Body, 256; Tail, 136; Hind-foot, 56 m. m.

My earliest record of the spring appearance of this species is March 9, in 1901, when one was seen to enter a hole in a decayed tree stump. At the time the ground was covered with snow and we experienced several hard freezes after that date.

One of their favorite foods is the hazel nut.

Evotomys gapperi (Red-backed Mouse).

Two were seen on November 1, 1901, both under corn shocks on the border of a thicket. One of these, a ♂, No. 1062, was captured.

I have no other record of its occurrence here.

Zapus hudsonius (Jumping Mouse).

Of this long-tailed, kangaroo-like Mouse, I have but four records:

First, a living one seen in a meadow near the thicket where the *Evotomys* was taken, on July 23, 1889. It was not captured.

Second, one my father caught in September, 1898, while I was in Alaska, and which he laid aside for me. I returned October 22, at which time it was in such a stage of mortification that I could not prepare it.

Third, one captured on May 21, 1901, No. 969, within 100 yards of the place the *Evotomys* was taken.

Fourth, one captured October 12, 1901, No. 1045, by my father, on almost exactly the same spot as the last one.

All of these were taken on the border, or within 200 feet, of the same thicket.

Peromyscus bairdi (Michigan Wood Mouse.)

This rodent is surpassed in numbers, in my locality, only by the Common Vole (*Microtus pennsylvanicus*).

It is abundant with us, frequenting fields, meadows, along rail fences, stone walls and in the timberland. If you see an old rail fence, overgrown by weeds and hazel bushes, be assured that *P. bairdi* are found there in numbers. Here they have their cozy home within some hollow rail. On one occasion I found nine adult individuals in one such nest.

These Mice gather in considerable numbers under shocks of grain standing in the fields, but aside from occasionally cutting the bands of bundles they do little or no harm.

Peromyscus leucopus (White-footed or Wood Mouse).

Our White-footed Mouse of the *leucopus* group may, by subsequent study, prove to be the sub-species *noveboracensis.*

This species occurs sparingly with us in the ratio of 50 *bairdi* to one *leucopus.*

Though generally considered more of a woodland species than *bairdi,* yet I have taken them in traps in grassy fields a mile from any timber.

Mus decumanus (Brown or Norway Rat).

Common about barns, in basement cellars, under grain stacks, in fields during the summer, about stone walls—anywhere that food can be found and sufficient cover to their taste.

In September, 1899, one was seen running along the beach at Fox Lake, fully a mile from any building.

Mus musculus (House Mouse).

Abundant, about buildings and in the fields, often taken in small traps set for Voles, Wood Mice and Shrews.

Microtus pennsylvanicus (Common Meadow Vole).

Beyond all question the most abundant mammal of Dodge County, even outnumbering the Common Mouse and Brown Rat.

They may be found in pastures, fields, meadows, marshes, both dry and flooded, along fences—practically everywhere except in woodland. Some years they are exceedingly abundant in a given field, and the next season, under precisely similar circumstances not one can be found there. My only explanation for this is that they may perform slight migrations, from one location to another. One season a certain clover field contained hundreds of them, the next season the clover crop was even heavier than the previous year, but not one could be found.

This species brings forth two and perhaps three litters per year, varying from 5 to 9 young, in number, though on but one occasion have I observed the latter number. A farmer once reported a nest of 12 young, six of which were one-half the size of the other six. In this instance it is fair to presume that two females occupied the same nest as their home.

My collection contains four albinos of this Mouse, 3 females and one male, taken as follows: August 7, September 14, September 29 and September 30, all in 1899. No other albinos have been seen or reported to me. These were taken on the farm, 3 in one field and the fourth one fully half a mile distant.

Microtus austerus (Prairie Meadow Vole).

Of this Vole I have a single record, one taken by a friend on April 26, 1896, No. 1021, who, noting its color, thought it might be something desirable to me. Not being at home at the time it was put in a jar of alcohol. Subsequently it was removed and a skin prepared. It was labelled "Taken on land," by which I infer that the collector wished to state that it was not taken in timberland or on the marshes.

It should occur commonly within our county and probably does in some localities not yet visited by me.

Sciuropterus volans (Flying Squirrel).

This form of the Flying Squirrel is common about Beaver Dam, making its home within the recesses of hollow trees and in old woodpecker excavations.

They sometimes congregate in large numbers in some snug retreat, to pass the winter. An instance of 22 being found in one hollow oak is recorded by the writer in *The Oregon Naturalist* of January, 1897.

Sciurus ludovicianus (Western Fox Squirrel).

In the immediate vicinity of Beaver Dam this is the only Squirrel which can be classed as common. They may be found inhabiting nearly every bit of timberland, and sometimes even in groves of not more than 50 trees.

In winter they make their homes within some hollow tree, in a great nest of dry leaves, where they lie curled up in severe weather, but on warm days may be seen running about, digging in the snow for food. In the spring, when the oak leaves have reached their full development, the Squirrel builds a huge leaf nest in some tree, usually near the top, in which the baby squirrels are born, and to which the parents repair for their night's rest and sleep.

Two black ones were killed in Trenton township some 15 years ago, and I frequently saw one black one during the winter of

1900-1901. These are the only cases of complete melanism of which I have record (that is, as pertains to Dodge County).

I have in my possession three interesting specimens tending toward melanism:

No. 1093, ♂, taken during December, 1891, at Fox Lake, by G. A. Morrison.

No. 1440, ♀, taken October 23, 1899, by Fred. Kimball.

No. 1470, ♀, taken December 19, 1899, by the writer.

These three have the under surface, inside of legs, throat, low jaws and cheeks black, elsewhere their color is somewhat darker than usual in *ludovicianus*.

Sciurus leucotis (Northern Gray Squirrel).

In 1888, when I came to Beaver Dam, I found the Gray Squirrel common and a Fox Squirrel was a prize indeed. About 1896 the Fox Squirrel increased wonderfully in numbers and apparently has driven out the Gray, and now the *latter* is the hunter's prize. Elsewhere in the county, notably about Randolph and in Oak Grove townships, the Gray is still common. Since 1898 I have seen but one *leucotis* on the farm—that one on July 18, 1901.

Last September I mounted a snowy white albino, which had been killed five miles south of town, on Sept. 5th. The eyes were pink and its coat of fur immaculate.

One skull in my possession, No. 1535, from Jefferson Co., shows an abnormal condition of growth of the incisor teeth. The two upper and right lower incisors are of unusual length. The other lower incisor is broken off close to the jaw bone. In this section of the jaw a shot is imbedded—which explains the strange growth. In early life this incisor was broken, and the others, lacking the usual opposition, became abnormally elongated and de-
This squirrel was fat and appeared healthy.
veloped in the form of a curve.

Sciurus hypophaeus (Merriam's Squirrel.)

The remarks which have just been made about *Sciurus leucotis* apply equally well to this species, although *hypophaeus* appears to be common in but one locality—that near Randolph. This species has been driven out by the Fox Squirrel.

From January, 1899, to the present date I have seen but one near my home—that one having been seen the past summer.

Merriam's Squirrel is apparently, in its distribution, restricted to Wisconsin and Minnesota. Black phases appear to be not rare in Minnesota and Dunn Co., Wis.

Sciurus hudsonius loquax (Southern Red Squirrel.)

Frequently, during my residence here, Red Squirrels have been reported to me. In reply to a request to my informants to bring me one I have received several Fox Squirrels, and I had really begun to doubt the occurrence of the Chickaree in Dodge County.

Imagine, therefore, the pleasure to me, to have a youthful hunter of this city bring me one of these squirrels, which he had shot on Oct. 30th last, about 8 miles southwest of this city. The day he obtained this one was a bright, warm day, and he chanced upon a woods (consisting wholly of oak), where, he tells me, he could have taken a dozen on that day, but only shot one, because he did not know whether they were anything I cared for. He subsequently visited the woods, but always on stormy, cloudy days, when there were few to be seen, and brought me three more.

Arctomys monax (Woodchuck.)

Known locally as Woodchuck. I have never heard "Ground Hog" applied to this animal about here.

An abundant rodent, frequenting woodland, meadows, stone fences and pasture lands. Some years more abundant than others. His excavations in the meadows are a menace to horses, owing to their stumbling into them and occasionally breaking a leg, otherwise they do little harm.

One has been observed with abnormal inciscor development, as had the squirrel mentioned elsewhere in this paper.

One season, a few years ago, they were so abundant that at least 47 were killed upon our 400 acre farm.

A favorite home site of the Woodchuck is the little groves surrounded by marsh land, upon every one (of which I have knowledge), in this vicinity (some 16 in number), a den may be found. And one colony has become established on an island, of perhaps three-fourths of an acre in extent, in our lake.

During 13 years' residence here I have seen this animal abroad every month of the year except December and January. A warm spell, in early February, will call him forth, though snow yet covers the ground.

The largest one which I have ever weighed tipped the scales at 12 pounds, less 3 ounces. One black one has been reported.

Not infrequently do I find them in trees. One old settler had taken up his abode in a timber lot and in the midst of a patch of blackberry bushes. These bushes hid his view, so he selected a near-by oak as his sentinel tower, and approaching the den one would be sure to see him up his tree, at a height of about 8 feet, from which he would slide down, when you approached too near, and scamper away to his den.

Fiber zibethicus (Muskrat.)

An abundant resident of our flooded marshes and found sparingly along streams and ditches. In the former place he erects his mud house, in the latter his home is in the banks, with the entrance under water.

Some winters large numbers leave the marshes and wander over the country. Of 120 such wanderers taken, 90 proved to be males.

Mephitis sp. (Skunk.)

Our local Skunk is presumably the Northern Plains Skunk—*Mephitis hudsonica.*

This animal is common in the county, though rather scarce in my immediate neighborhood, due to persistent trapping.

The Skunk is nocturnal, though on two occasions I have seen them abroad during daylight. One late October day I saw a jet black one run through a pasture, about 3 P. M., and enter one of the 6 entrances to an old established Woodchuck colony. As this stage of pelage was worth about $5.00 at the time, and being a boy trapper in my 'teens, I coveted that particular animal, but my work held me down until some time after sunset. I then hastened to the place and carefully set a trap at each opening, and there the traps remained undisturbed for 4 days. My coveted prize evidently having left the dens the day he was seen and ere I had my traps set.

The other was seen running along the lake shore on a bright June day, and my companion shot it, but not before it had made itself known in its own peculiar manner. This one was normally marked.

A series of this mammal shows considerable variation in the amount and distribution of the white stripes. One albino has come to my notice.

This is one of our most beneficial mammals, though he does occasionally visit the farmers' poultry house. Show me a meadow with little holes dug here and there at the roots of the grass, and I will prove to you that the meadow is infested with white grubs—the larvæ of the June bug (Order Coleoptera-genus Lachuosterna)—which are a favorite food of the skunk. Besides grubs he destroys large numbers of grass-hoppers, injurious beetles, and other detrimental insects.

Taxidea Americana (American Badger.)

This animal, which figures so conspicuously on our state shield, was once common in Dodge County, but at the present day I dare venture the assertion that there are not upward of a dozen living examples left. The settlement of the country, above all other causes, has driven them away, for this is an animal which loves solitude.

During the past 12 years 3 or 4 live ones have been exhibited at our county fair, mostly taken in Burnett Township, but I am told there are none left there now.

A den was located in that township, some 4 years ago, on Col. Lockwood's farm. The Colonel would suffer no one to molest, them, but the Colonel left the farm two years ago and I have heard no more about the Badgers.

Several years ago I gave up all hope of securing one from our county for my collection. Last fall two young men called on me to enquire if I would buy a Badger, if they caught one. I assured them I would, never expecting to hear more about it. But on Jan. 9th, of this year, one of these boys brought me the Badger, caught in a steel trap, which had been set in the mouth of its burrow the night before.

This one, No. 1089, was a ♂, very fat and large, weighing 19 lbs. It was taken 5 miles south of Beaver Dam, the burrow being situated in a strip of woodland.

The teeth show no wear, from which I judge that it is a young animal.

Procyon lotor (Raccoon.)

Occasionally taken in the more heavily timbered parts of the county. Seldom a winter passes but that I hear of the capture of one or two.

One taken near Randolph on Oct. 21, 1900 (No. 1843), weighed 11½ lbs. Sex ♂

The majority of reported captures show this animal to prefer the vicinity of some lake or water course, as his domain.

Vulpes fulvus (Red Fox.)

Not rare, throughout the county, becoming scarcer gradually, is the opinion of fox hunters in general. Not a winter passes but that I learn of one or more seen or captured. Favorite localities appear to be Trenton and Burnett Townships, and in the country surrounding Horicon marsh.

Vulpes fulvus argentatus (Silver Fox.)

Rare, if it occurs at all, at the present day. When the country was new and but thinly settled it was occasionally taken, the older settlers inform me.

I was one of three lads to start one from an arbor vitæ hedge within the city, where every lot had a house upon it and five blocks from Front street, in 1890. It was shot and its pelt sold for $35. Since then none have been reported.

Lutra canadensis (Land Otter.)

The Otter was common in our county in the days of its early settlement, but has been practically, perhaps wholly, exterminated. Adam Egotz, once a professional hunter and trapper, and a man whose word may be relied upon, tells me he saw the slide of one of these animals on the shore of Beaver Dam Lake early in the '90's. He endeavored to trap it, but without success, and it soon disappeared.

I also have one other record of one actually captured here some time since 1890, but the record is not accessible at the time of this writing.

Lynx rufus (Wild Cat.)

Not rare when the forests covered the greater part of our country 20 to 40 years ago.

In October, 1898, one was killed near Alderly, this county.

Sorex richardsoni (Richardson's Shrew.)

Of this Shrew I have but one record, ♀ (No. 1183), which a Shrike had impaled on a willow, in a large marsh, found on April 1, 1899.

Persistent trapping in the surrounding marshes has failed to secure another specimen.

Sorex personatus (Masked Shrew.)

Of this *Sorex* I have five records: First, No. 1369, one caught by father under a barley shock, at noon (we were working in different fields that day). He told me he had a shrew the like of which he had never seen before, and characterized it by calling it a "mouse-colored Shrew." This was on July 31, 1899.

Second—No. 1493, trapped by me along a grassy fence line on Jan. 10, 1900.

Third—One found lying between the railway rails at Minnesota Junction on Sept. 1, 1900. It was too far advanced in decomposition to preserve.

Fourth—No. 1883, caught Dec. 13, 1900, as it ran from under a log in a grove of oaks, a grove covering fully an acre.

Fifth—No. 951, found dead on March 15, 1901, near the barns.

It will be observed that these five were found in various locations—in timber, grain fields and along fence lines. From this fact, and also owing to its diminutive size, swift movements and nocturnal, retiring habits, I feel assured that it is a common species, though so seldom observed.

Blarina brevicauda (Short-tailed Shrew.)

This Shrew is common about stone walls, rail fences and under brush piles in the woods, and large boulders about the fields.

It is nocturnal in habits, though occasionally seen abroad in the day.

This species is the bane of the trapper of small rodents. Often do I find in my traps a *Peromyscus* or *Microtus,* which has been ruined for a skin, by this carnivorous creature.

Lepus floridanus mearnsi (Western Cotton-tail.)

The Western Hare is common, and even abundant, in some districts, and scarce in others. They frequent all conditions of habitats, excepting the flooded marshes, but prefer woodland and grassy, weedy tracts.

In severe weather they spend their hours in some excavation in the earth, made by a skunk or woodchuck. I have no proof that they ever excavate their own homes. During the warm months they may be found scattered over the fields and meadows.

Hunters have brought me reports from time to time of a very large big-eared Rabbit, occurring in a tamarack swamp near Lost Lake. It is unlikely that any Jack Rabbits occur in Wisconsin, and as these are said to be brown in winter as well as summer, they cannot be the Varying Hare (*Lepus Americanus*). a species common in northern Minnesota and presumably occurring in northern Wisconsin. Their big-eared fellows are presumably very large examples of the common western form of *floridanus.*

The 27th of last October, a local hunter killed a Rabbit which had a white stripe, extending upward from its nose to the base of the ears. Its greatest width is nearly an inch. The head was left for me at a local store, and, on subsequent inquiry, I was informed that the rabbit was otherwise marked as common with the species.

Lutreola vison (Mink.)

The Mink is a common resident of our marsh lands and timbers bordering on the various lakes of the county, where they find food abundant, for rarely do I learn of their depredations on poultry houses.

In the marshes they find frogs, crayfish, mice and eggs in abundance during the warmer months; in winter they find mice, and doubtless also catch some fish.

The Mink is a cautious animal, one that does not foolishly set his foot on the pan of a steel trap, so the "kid trapper," as the professional trapper calls the youthful school boy, secures but few, perhaps not one, in a season. Consequently their numbers do not seem to diminish. The winter of 1900-1901 they were unusually common, judging from reports from all over the county.

Personally, but one has been seen, far from a marsh. This one was seen running through a stubble field about mid-day, on Aug. 6, 1889.

Hohl's woods, about four miles north of town, with its high banks, projecting tree roots, and shore line of great bowlders, is a favorite home of the Mink.

Putorius cicognani (Bonaparte's Weasel.)

In a series of 16 Weasels from Dodge County, submitted to Dr. Merriam, he found 4 of this species and 12 of the New York Weasel. This may, I think, be taken to show the ratio in abundance of the two species, for considering the two together, it can be said that Weasels are abundant with us. This series represented individuals from various habitats and all stages of pelage.

This species has been taken in burrows in timber land, in marshes, along the lake shore and about stone walls.

Putorius noveboracensis (New York Weasel.)

The relative abundance of this Weasel I have stated under the remarks on the preceding species.

Lasiurus borealis (Red Bat.)

The Red Bat is an abundant species with us, being partial to timber, about ponds, lakes and streams, from whence I judge that it feeds largely on mosquitoes and other *Diptera* of similar habits.

Lasiurus cinerea (Hoary Bat.)

The past season I first met this large, interesting Bat. Early in September, I observed a large bat flying among the burr oaks scattered about in an upland pasture. They seemed to come, at dusk, from the trees, but a thorough search made one day of some

30 trees, I failed to find a bat. That they were there I feel sure, which goes to show how well their color and position harmonize with their surroundings, when hanging head downward, with their wings wrapped about them, as they take their daylight sleep. When they first appeared each evening they would fly close about the trees, within the dark shadows, then rise high in the air and work off toward the northwest. This northwestward movement was observed each evening when I visited their haunts.

One was found dead on the ground, evidently in nowise injured, by which I learned their identity.

I *certainly* had never seen them here before, which can be explained when we remember the well-known migratory habits of the bat tribe.

Lasionycteris noctivagans (Silvery Black Bat.)

An abundant species, particularly so about the streets of the city, in the early evening, where they may be seen in numbers, darting about among the trees.

I have knowledge of several houses, where these bats roost in large numbers between the closed blinds and the windows. One of these roosts was investigated one year, during the height of the bat season, and there was an almost solid column of bats the whole length of the blind—clinging to blind and window casings—a conservative estimate being 300 bats.

Myotis lucifugus (Little Brown Bat.)

This species came with the migration of Hoary Bats in September, 1901, previous to which I had never taken them.

One morning some 60 were found in a granary, having gained access through a broken window pane. They used this roost for only three nights, after which they were seen no more.

Castor fiber (Beaver.)

Exterminated Species.

The Beavers, many years ago, had constructed a dam on the creek which flows out of the present lake at this place. Prior to that time our lake was merely a stream flowing through extensive marshes. This dam gave to our city its present name, but the Beaver has long since disappeared from the county.

Odocoileus virginianus (Common Deer.)

Many years ago these ruminants occurred here, so old settlers inform me.

The Porcupine (*Erethizon dorsatum*) and the Black Bear (*Ursus americanus*) doubtless were found here years ago, and the Canada Lynx (*Lynx canadensis*) doubtless has occurred.

S.N.A. No.

JUL 25 1902

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BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY

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MILWAUKEE, WISCONSIN.

EVENING WISCONSIN CO., PRINTERS, MILWAUKEE.

The Wisconsin Natural History Society,

MILWAUKEE, WISCONSIN.

ORGANIZED MAY 6, 1857.

OFFICERS AND DIRECTORS.

EDGAR E. TELLER, PRESIDENT . . . . . . 170 29th Street, Milwaukee
DR. CHAS. D. STANHOPE, VICE PRES'T . 204 Grand Ave., Milwaukee
CHARLES E. MONROE, GEN. SEC'Y . 310 Goldsmith Bldg., Milwaukee
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Ornithology	Edward E. Voss

REGULAR MEETINGS.

These are all held in the Society's lecture room in the Museum-Library Building, Milwaukee.

Meetings of the combined biological sections take place on the 2nd Thursday of each Month at 8 P. M.

The Archeology and Numismatics sections meet on the 3rd Thursday of each Month.

General Meetings are on the last Thursday of each Month except July and August.

Meetings of the Archeologists and collectors of the State are to be held semi-annually under the direction of the Archeology section, for the purpose of furthering the cause of Wisconsin Archeology.

PUBLICATIONS.

The "Bulletin of the Wisconsin Natural History Society."
The "Wisconsin Archeologist."

MEMBERSHIP DUES.

City Members, $3.00 per annum; Non-resident Members, $1.00 per annum; Life Members, one payment of fifty dollars.

JUL 26 1902

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

VOL. 2, New Series. JULY, 1902. No. 3.

Exchanges should be mailed to the Wisconsin Natural History Society, in care of the Public Museum, Milwaukee, Wis. Communications should be addressed to the General Secretary.

Summary of the Proceedings of the Society.

March, April, May and June, 1902.

THURSDAY, March 27, 1902.

The meeting was called to order by the president, Mr. Edgar E. Teller.

There was a large attendance both of visitors and members.

The president read a communication from Mr. William J. Bennetts, the recording secretary, tendering his resignation on account of the fact that he was about to leave the city. The resignation was regretfully accepted.

Mr. Charles E. Monroe was elected recording secretary to fill the vacancy thus caused.

Mr. Charles E. Brown, general secretary of sections, presented a report of the section meetings held during the month.

The following names were reported: Mr. Emil Schenck, of Deerfield, for active membership; Mr. E. H. Stiles, of Richland City, for honorary membership. Referred to the board of directors for their action.

Mr. Carl H. Doerflinger, in behalf of the committee on revision of charter and by-laws, presented a revised draft of the articles of association of the society. Action thereon was deferred until the next regular meeting.

Mr. Charles E. Brown gave notice of the recent deaths of Frederick Rauterberg and Herbert J. Johnson, members of the society. The secretary was instructed to express to the families of the deceased the sense of loss felt by the society in the death of members so actively interested in scientific pursuits, and the sympathy of its members in their bereavement.

Prof. Stuart Weller, of the University of Chicago, was then introduced by the president and delivered an interesting address on "The Northern Rocky Mountains." The lecturer gave an account of the work done during the previous summer by an expedition sent out by the United States government to determine and mark the boundary line between the state of Montana and the British province of Alberta. The lecture was illustrated with lantern slides showing the scenery, geology and topography of the region traversed. One of the most striking features represented was an extraordinary fault, with over-thrust, resulting in the super-position of primary rocks above later cretaceous formations.

A vote of thanks was extended to the lecturer.

The meeting then adjourned.

THURSDAY, April 24, 1902.

Annual meeting of the society; thirty-three members present.

In the absence of the president and at the request of the vice-president the meeting was called to order by the recording secretary.

On motion of Mr. Ernest Bruncken, Dr. George W. Peckham was requested to take the chair and did so.

The minutes of the previous meeting were read and approved.

Mr. Charles E. Brown presented a report of section meetings held during the month.

Mr. George A. West, treasurer, presented his report for the year, containing the following statement:

Cash on hand May 1, 1901	$232.73	
Cash received during year from dues of members	287.95	
	———	$520.68
Total disbursements during year	$417.57	
Balance on hand April 24, 1902	103.11	
	———	$520.68

Messrs. David Harlowe, Charles D. Stanhope and Charles E. Brown were appointed a committee to audit the treasurer's report.

Mr. Charles E. Brown, as secretary of sections, presented a report for the year showing a large gain in membership and increased interest in the work of the sections. The archeological section embraced 102 members, from all parts of the state. Efforts would be made to increase the membership of the botanical and ornithological sections during the coming year. The report recommended that each section be given full power to formulate its own by-laws and elect its own director.

The amendments to the articles of association proposed by the committee on revision were read by the secretary. Final action on the proposed amendments was deferred until the next monthly meeting in order that proxies might be obtained from absent members after full information had been given them of the character of the proposed amendments.

Applications for membership were received from the following persons: Charles H. Yunker, Dr. F. F. John, Arthur Nuesse and Dr. Otto C. Thienhaus, all of Milwaukee; F. M. Le Count, of Hartford; N. E. Carter, Elkhorn; M. E. Morrissy, St. Francis; N. Hollister, Delavan. Referred to the Board of Directors.

The secretary offered a resolution 'that the transfer heretofore made to the Public Museum of the city of Milwaukee of the collection of books and pamphlets in the possession of the society, as well as of others which may hereafter come into its possession, be and is ratified and approved by the society." Action upon the foregoing resolution was deferred for one month in order that proxies might be secured from absent members upon the resolution.

On motion of Mr. Henry R. Dennison an informal ballot was taken for president for the ensuing year. Thirty ballots were cast, of which Mr. Edgar E. Teller received twenty-five. The secretary was instructed to cast the unanimous ballot of the society for Mr. Teller, which was done and Mr. Teller was declared unanimously elected.

Other officers were then elected as follows:

Vice-President—Dr. Charles D. Stanhope.

Recording Secretary—Mr. Charles E. Monroe.

Corresponding Secretary—Mr. Charles E. Brown.

Treasurer—Mr. Lee R. Whitney.

Librarian—Mr. Adolph Biersach.

The meeting then adjourned.

THURSDAY, May 29, 1902.

The meeting was called to order by the president, Mr. E. E. Teller; twenty-two members present.

The minutes of the annual meeting were read and approved.

The secretary moved the adoption of the following by-law: "Any member may vote by proxy on any matter at any meeting." The motion was carried unanimously and the by-law adopted.

The question of the adoption of the amended articles of association, recommended by the committee on charter revision at the last meeting and laid over for one month, came up for final action, due notice of the proposed amendments having been mailed to all the members of the society by the recording secretary pursuant to the order of the board of directors.

The amended articles of association were then read and approved section by section and then adopted as a whole by the unanimous vote of the twenty-two members present and of eighty-four proxies held and voted by the following persons: By the secretary, 61; by Mr. Charles E. Brown, 12; by Dr. Charles D. Stanhope, 7; by Mr. Lee R. Whitney, 2; by Mr. Charles H. Doerflinger, 1; by Mr. Adolph Biersach, 1; making a total of 106 votes.

(A copy of the amended articles of association is printed elsewhere in this Bulletin.)

The resolution "that the transfer heretofore made to the Public Museum of the City of Milwaukee of the collection of books and pamphlets in the possession of the society, as well as of others which may hereafter come into its possession, be and is ratified and approved by the society," offered by the secretary at the last meeting and laid over for one month, then came up for action by the society, due notice of the resolution having been mailed to every member of the society by the recording secretary pursuant to the order of the board of directors.

The resolution was adopted by the following vote:

Members present voting for the resolution........	20
Proxies held and voted by the secretary...........	61
Proxies held and voted by Mr. Brown.............	12
Proxies held and voted by Mr. Whitney...........	2
Proxy held and voted by Mr. Doerflinger.........	1
Proxy held and voted by Mr. Biersach............	1
Total..................................	97

Opposed to the resolution were the following:

Members present voting against the resolution.....	2
Proxies held and voted by Dr. Stanhope..........	7
Proxy held and voted by Mr. Denison............	1
Total..................................	10

The secretary reported that the following persons had been elected to membership at a meeting of the board of directors held May 8:

Honorary member, E. H. Stiles, of Richland City.

Active members: Charles H. Yunker, Dr. F. F. John, Arthur Nuesse and Dr. Oscar C. Thienhaus, all of Milwaukee; Emil

Schenck, Deerfield; F. M. Le Count, Hartford; N. E. Carter, Elkhorn; M. E. Morrissy, St. Francis; N. Hollister, Delavan.

The offices of corresponding and recording secretaries having been abolished by the amended articles of association just adopted, and the offices of general secretary and an additional director having been created, an election was then held to fill the new offices.

Mr. Charles E. Brown was unanimously elected a director.

Mr. Charles E. Monroe was unanimously elected general secretary.

The committee on revision of charter and by-laws made a further report, recommending the adoption of a new set of bylaws, prepared by the committee, as a substitute for the existing by-laws.

The proposed new by-laws were then read section by section, and after some amendments had been made, were unanimously adopted.

(A copy of the new by-laws is printed elsewhere in this Bulletin.)

Mr. Denison moved that a committee of three be appointed to report upon members who had died during the preceding year with suitable resolutions. The motion was unanimously adopted and the president appointed Messrs. Denison, Doerflinger and Brown such committee.

The application for membership of Rev. E. C. Mitchell, of St. Paul, Minn., was presented and referred to the board of directors.

The meeting then adjourned.

THURSDAY, June 26, 1902.

Meeting called to order by the president; thirty persons present.

The minutes of the last meeting were read and approved.

Messrs. H. R. Denison, C. H. Doerflinger and C. E. Brown, the committee appointed at the last meeting, presented the following memorials and resolution:

CHARLES VON BAUMBACH.

Born at Kirchheim, in the Grand Duchy of Hessen, on June 18, 1840, a scion of an ancient family, he came to this country in 1848 with his father, who had been implicated in the revolutionary movement of the time, and settled in Ohio. After receiving a good education he came to Milwaukee with the family in 1857, the year when our society was organized. He contributed to its early collections specimens bagged on his hunting expeditions in Wisconsin and in the south, where he served in defense of the Union from the beginning of the civil war until November, 1863. He joined Company C of the Fifth Wisconsin Infantry, as a private, was promoted to the positions of corporal, sergeant and second lieutenant; then joined the Twenty-fourth Wisconsin Infantry as captain of Company C, and became major of that regiment. He took part in the Peninsula campaign, the siege of Yorktown, and the battle of Williamsburg, where he was wounded; also in all the battles in which the Twenty-fourth Wisconsin was engaged until the time of his resignation on November 28, 1863.

Actively interested in all cultural endeavors, after his return from the field, he became a member of our society in 1866 and remained true to it until the day of his demise, which occurred at his home in Milwaukee on December 23, 1901, after a successful business career as a pharmacist, and founder and head of the wholesale drug firms of Baumbach & Rosenthal, Charles Baumbach Company, and Baumbach, Reichel & Company.

Charles von Baumbach will be remembered by his comrades in arms, by the older members of our society, and a host of other friends, as a genial companion and public-spirited citizen.

ADAM CONRATH.

This name first appears on the membership list of our society in 1881. At the time of his premature death, at the age of 52 years, on December 19, 1901, he had therefore been a member for twenty years.

Graduated with high honors from the Philadelphia College of Pharmacy on March 11, 1873, he became one of the most studious and enthusiastic of his profession, interested not only in *materia medica,* but especially in botany, his favorite branch of science, and in archeology.

On April 3, 1881, he was elected one of the directors of botany and was re-elected many times in subsequent years. The society's museum, now the Public Museum of the City of Milwaukee, received many gifts from him, particularly for the herbarium. He gave much attention to the observation of alien plants introduced and naturalized in Wisconsin and contributed to the known flora of the state a number of species he first discovered. He contributed many papers and shorter communications at the meetings of our society.

For many years he was associated with Hon. Chris. Widule in the drug firm of Widule & Conrath. As a member of the State

Board of Pharmacy he conducted or participated in the preparation of its examinations.

He collected one of the most complete herbaria of Wisconsin plants and his enthusiasm moved many students to put forth their best efforts.

He was an active and valuable member of our society, a pleasing colleague and helpful collaborator.

AUGUST HECKER.

He was born at Selters, province of Nassau, on June 17, 1834, received a good education and with it imbibed a warm appreciation of the beauties and wonders of nature. He was a very young man when he emigrated in 1850, was soon engaged in the wholesale grocer firm of Inbusch Bros. and served the same house for 50 years as a traveling agent and business representative. He was interested in natural history, literature and music. While he did not make any systematic collections himself he brought many specimens for the museum from his business trips and hunting expeditions. He belonged to the Wisconsin Natural History Society as early as 1868, remaining a member until his death, which occurred on April 23, 1901.

Warm-tempered, like the volcanic region of his birth, he was quick to do good and ever ready to support a good cause. His heart has come to rest under the monument set for him by love in Forest Home Cemetery, where Flora's children offer their fragrant blossoms and his little winged and feathered friends sing sweet tunes to the accompaniment of Aeol's harp.

Resolved, That the foregoing memorials to our deceased members, Charles von Baumbach, Adam Conrath and August Hecker, be spread upon the records of the society and that the general secretary be instructed to send a copy of them to the families of the deceased with appropriate expressions of condolence on behalf of the society.

The foregoing resolution was unanimously adopted.

Mr. Brown presented reports of section meetings as follows:

1. A meeting of the combined biological sections, held June 12. At this meeting Mr. Adolph Biersach was unanimously elected secretary for the ensuing year. The election of directors of sections was deferred until the fall. Dr. S. Graenicher read a paper on "Insects Bred from Elder Stems." Mr. Brown described some fungi new to the Milwaukee County list, exhibiting specimens.

2. A meeting of the archeological section, held June 19. At this meeting the secretary presented his annual report. Plans were discussed for the work of the coming season. Mr. Henry A. Crosby was elected director. Messrs. W. H. Elkey of Milwaukee and P. O. Griste of East Troy, presented some notable exhibits.

The general secretary reported that Rev. E. C. Mitchell, of St. Paul, Minn., had been duly elected a member of the society by the board of directors at a meeting held May 29, 1902.

Dr. George P. Barth then exhibited and described the advantages of a new type of artificial ants' nest. This consists of two glass jars or bottles, one within the other, the space between the two being filled with sand. This contrivance permits the ants to excavate both vertical and horizontal burrows, capable of easy examination and easy to handle, and seemed to the speaker to possess advantages over the flat nests.

Hon. Publius V. Lawson, of Menasha, read a paper on "The Buried Forests of the Fox River Valley." (A summary of this paper is printed elsewhere in this Bulletin.)

Applications for membership were received from Miss Olive C. Wheeler and Pierson L. Halsey, of Milwaukee; and from Bernhard Gerhard, of St. Louis, and P. H. Hamilton, of Two Rivers.

The meeting then adjourned.

Amended Articles of Association.

ARTICLE I.—This corporation being the successor of "Der Naturhistorische Verein von Wisconsin," is organized for the purpose of arousing and sustaining an interest in the study of Nature and especially of facts and materials pertaining to the natural history and ethnology of the State of Wisconsin.

ARTICLE II.—The name of this corporation shall be "The Wisconsin Natural History Society," and it shall be located in the City of Milwaukee in said State of Wisconsin.

ARTICLE III.—This corporation is formed without capital stock and no dividend or pecuniary profits shall be declared to the members thereof.

ARTICLE IV.—The general officers shall be President, Vice-President, General Secretary and Treasurer, and they, together with one additional member to be elected by the Society, shall constitute the Board of Directors.

All the officers herein specified shall be elected at the annual meeting. Vacancies in any office may be filled by election at any regular meeting.

ARTICLE V.—The principal duties of the several general officers shall be those usually pertaining to such offices and such other duties as may be prescribed by the by-laws of the corporation.

ARTICLE VI.—Members shall be elected by vote of the Board of Directors and shall pay such sum upon admission and such stated dues thereafter as may be required by the By-Laws.

Members may be discharged on their own request by striking their names from the list of members kept by the Secretary and Treasurer. Any member who is in arrears for dues for three years may be dropped from membership by the Board of Directors.

The Board may also elect honorary and corresponding members under such regulations as may be prescribed by the By-Laws, but such members shall have no voice in the management of the corporation.

Fifteen members shall constitute a quorum for the transaction of business, except where otherwise required by these articles.

ARTICLE VII.—All the collections and property of this corporation may, by the votes of a majority of all the members of the Society, be donated to the City of Milwaukee. Should the number of members at any time become reduced below eight, it shall be deemed dissolved, and its property shall thereupon become the property of the Public Museum of the City of Milwaukee.

The annual meeting of the Society shall be held on the last Thursday of April in each year. Regular meetings may be held at times prescribed by the By-Laws.

Proposed amendments of these articles may be presented at any regular meeting, but final action thereon shall not be taken before the next following regular meeting and notice of such proposed amendments shall be given to the members before the meeting at which they are to be acted upon, in such manner as the Society or its Board of Directors shall prescribe.

By-Laws.

1. The annual dues shall be $3.00 for resident and $1.00 for non-resident members, but members elected in any year shall be required to pay only for such portion of that year as shall remain between the date of their election and the first day of the following May.

Life membership may be obtained by a single contribution of $50.00.

2. Persons not residing in the city or county of Milwaukee may become corresponding members, if they endeavor to promote the aims and purposes of the Society.

3. Any person may be proposed for membership by any member, at any regular meeting.

4. Persons who have rendered prominent services to the Society or to its aims and purposes, may be elected honorary members.

5. The order of business at the annual meeting shall be as follows:

(a) Reading of the minutes of the last regular meeting.
(b) Unfinished business.
(c) Reports of officers.
(d) Election of officers.
(e) New business.

6. The regular meetings of the Society shall be held on the last Thursday of every month, except July and August. The order of business at such meetings shall be as follows:

(a) Reading of the minutes of the last meeting.
(b) Unfinished business.
(c) Reports of committees and officers.
(d) Correspondence.
(e) Reading of scientific papers and communications and discussion thereof.
(f) New business.

7. The Board of Directors shall transact all business usually performed by such bodies in accordance with the Articles of Association and these By-Laws.

8. The President shall be the presiding officer at all meetings, shall appoint all committees unless otherwise ordered by the members present, shall call extraordinary meetings upon the written request of three ordinary members, shall decide in case of equality of votes, and shall examine and sign all orders to the Treasurer.

9. The Vice-President shall take the place of the President in case of the latter's absence.

10. The General Secretary shall keep an accurate record of all transactions, shall preserve all reports and papers of the Society, keep an accurate list of all members, countersign all orders to the Treasurer, and conduct the correspondence of the Society.

11. The Treasurer shall keep in trust the funds of the Society, pay orders only when signed by the President and General Secretary, and shall present a financial statement at the annual meeting and at any other time when requested by the Board of Directors or the Society.

12. Each officer shall prepare a detailed account of his work during the year and report the same to the annual meeting.

13. The Board of Directors shall have authority to publish from time to time such portions of the proceedings of the Society and such scientific contributions, especially such as are the result of original investigation and research, as shall in their discretion be deemed advisable.

14. Any member may vote by proxy on any matter at any meeting.

15. Any three or more members may, subject to the approval of the Board of Directors, organize a section for work in some particular line within the general purpose of the Society. Such sections may adopt their own by-laws not inconsistent with these By-Laws or the Articles of Association. Sections shall report each month to the Society on their work. They shall not publish anything without being authorized to do so by the Board of Directors.

16. These By-Laws may be amended at any regular meeting by the votes of at least two-thirds of all the members present.

Studies in Plant Distribution.

By ERNEST BRUNCKEN.

3. Upland Brushwoods of the Milwaukee Region.

There are in the vicinity of Milwaukee numerous areas of greater or less extent which are covered with shrubs, either completely, so as to shade the ground and form what are substantially forest conditions; or in more or less sparsely scattered groups and individuals, with grass or herb-covered spaces between. The former type may be called thickets; the other heaths. As to thickets, the present inquiry will be confined principally to those occurring on dry uplands. The extensive thickets found in swamps and river bottoms have essentially different ecological relations, of great complexity, and will be considered only incidentally. As to heaths, the name implies their xerophytic nature. Similar areas of groups of shrubs in marshy land are frequent at some little distance from Milwaukee, but in the territory under discussion are of every limited extent.

There is no evidence at hand whether before settlement of the region upland brushwoods of either class occurred therein. Regarding similar bottom brushwoods the fact is of value that many of the very old trees still standing in the river bottoms have low branches, as if they had stood free at least from the height usually reached by the hydrophytic shrubs. Sometimes these low branches are developed on one side only, as if in its youth the tree had stood on the edge of a shrub-covered glade. (1)

If the absence of evidence to the contrary makes it probable that such glades were not found on the uplands, the shrubs which now compose the brushwoods must either have come to the region since the settlement, or have existed theretofore in the form of underbrush. The latter alternative is indicated by the great frequency of individuals, the considerable variety of species, and above all the fact that the same species to this day occur very commonly as underbrush, especially in the hemi-xerophytic forests. It is not every shrub, however, which occurs in the forest, that takes part in forming brushwoods. On the whole, it may be said that the thicket-forming shrubs are three in number: the witch hazel; the staghorn sumach, and the various species of hawthorn. A large number of other shrubs are liable to be found

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1. Of course this evidence is not complete. The glades may have been sedge marshes; only, if that was the case, one ought to occasionally find branches still lower than the height of 8 to 12 feet at which they mostly occur.

mingling with these, such as the hazelnut, choke cherry, prickly ash, and in rather moist places the black alderberry. All these, with the exception of the last-named species, have numerous xerophytic characteristics, as might be expected from their stations.

Before these brushwoods in their typical development are treated in detail, attention should be called to a formation intermediate between a young forest and brushwood. This hybrid formation is found where forest has been cut in a manner to favor the growth of stool shoots. Of the forest trees of the region, especially oak, basswood and ash are apt to form vigorous coppices, and it generally happens that simultaneously with the stool shoots the various shrubs mentioned spring up. For a while they contest vigorously for the occupation of space, but after some years the trees get the upper hand, and the shrubs fall back to the position of underbrush. The areas of this character are usually much less xerophytic than brush areas which have grown into thickets through the heath stage to be described below. Consequently, mesophytic shrubs, like various species of *Ribes,* which are never found in the heath, are common in them. The mesophytic conditions of these areas are easily explained by the fact that owing to the comparatively quick growth of the stool shoots the soil is not left uncovered as long as it is where no stool shoots are found. Consequently the humus accumulated while the forest was still standing is not so completely oxydized as where there are no stool shoots.

Where the removal of the original forest did not take place in such a manner as to give an opportunity for coppice growth, the first stage of plant life is a vigorous contest between grasses, especially several species of *Poa;* numerous stout herbs, such as asters, golden rod and sunflowers; and the shrubs. As may be expected the areas on which this contest is allowed to proceed undisturbed are almost entirely restricted to steep hillsides, especially those with a southern or western exposure. All better localities are needed for tilled fields, and natural processes of reclothing have no chance to operate. But the places indicated are of no use to the farmer except as pasture land, and are therefore left to themselves, except as to the more or less heavy cropping by his cattle. In addition to the strong insolation caused by their steepness and exposure, these hillsides are apt to be gravelly or full of boulders, so that the conditions are decidedly xerophytic. In the three-cornered fight between the grasses, herbs and shrubs the golden rods and their allies are the first to succumb. They last only so long as the forest litter has not yet entirely disappeared. When that has been accomplished the grass covers by far the greater portion of the surface. With its dense tangle of filiform roots, the dense sward of *Poa* makes it exceedingly difficult for other species to compete. About the only successful rivals are a number of minute mosses, and *Antennaria plantaginifolia.* The latter is almost always present, forming little groups and patches in the sward. Where there are other species in the grass carpet, it will invariably be found that they grow in places where from one cause or the other the sward has been broken or prevented from forming. Thus they will grow from under the edge of a boulder or cobble stone; out of a hole made by an animal; or a place where the surface water has laid the ground bare. Among the species conspicuous in such spots are *Fragaria virginiana; Viola sororia; Potentilla Canadensis;* here and there *Hedeoma pulegioides;* further *Monarda fistulosa; Verbascum thapsus.* It will be noticed that many of these xerophytic heath plants have creeping root stocks, runners and stolons, which fit them to compete with the dense grass better than propagation by seeds could do. Of late years the common ragweed invades these dry hillside pastures in great numbers. It colonizes especially places where sod has been removed, and thence spreads to every bare spot it can reach. Occasionally places are found where one of these herbs, most often *Potentilla,* has managed to drive out the grass from considerable areas, and now forms an exclusive carpet many square feet in extent.

In the meantime, the shrubs which started out evenly with the grasses have established themselves in groups here and there. It is especially *Crataegus* which has its favorite habitat on these dry heaths. There are in this vicinity probably some six or seven distinct species of this genus. But as they have never been thoroughly studied taxonomically, they may simply be grouped as *C. coccinea, C. mollis* and *C. punctata,* with their respective allies. They occur within the forest as well as on the heath. But as they need a great deal of light they are apt to assume quite eccentric forms in shady places. Their normal adult form is that of a low tree with spreading crowns, approaching the umbrella-like shape so common in *Mimosa* and other trees of tropical and subtropical savannas. In deeply-shaded woods, on the contrary, they shoot up high, with few and thin branches. I have seen hawthorn trees twenty feet high, two inches in diameter, bearing no branches below a height of ten feet above the ground, and then sending out but few and short ones, without the multitude of spurs that make the typical crown of a hawthorn so dense.

An old hawthorn on the heath, however, usually has a sturdy trunk, five or six inches in diameter. Its crown is disposed like a number of galleries one above the other, with distinct intervals;

the tips of the branches sweep within a few feet of the ground. Under its immediate shade the ground is bare of vegetation; but at the edge of the bare spot there is often a ring of mesophytic or moderately xerophytic herbs, such as golden rod, violets, milkweed, etc. The younger individuals of hawthorn are apt to suffer much from cattle and in their efforts to protect themselves often assume the grotesque shapes described elsewhere. (1) As a result, they remain shrubby much oftener than would be the case if the normal tendency of the genus to assume the tree-like form had its full sway.

It is very noticeable that the shrubs and small trees scattered over the heath tend to grow in groups. It is rare to find a single shrub or young tree. The reason for this may be that single seedlings are almost certain to be eaten or trampled by cattle, while where they occur in patches or groups, some of them at least have a chance of surviving. When they are a few years old, the young shrubs begin to protect each other. The older a group becomes, the more mesophytic the conditions in their midst and for a few feet beyond become, especially on their north and east sides. Soon many mesophytic herbs, such as *Podophyllum peltatum, Anemone nemorosa,* asters, golden rod and sun flowers reappear, while *Poa* gradually dies out. More mesophytic shrubs soon make their reappearance. By and by the group develops into a small thicket, and as this spreads and joins with its neighbors, the whole heath may in time be converted into a thicket. While this goes on, young trees, especially oaks and hickories, will have found favorable lodging places among the shrubs, and the development will, if undisturbed, progress until the mesophytic forest has again taken possession of the area.

On heaths of this description, the various species of *Crataegus* are decidedly dominant among the shrubs. The other species most frequently found are the hazelnut and two species of sumach, *Rhus typhina* and *Rh. glabra.* (2) There are, of course, a good many others, such as *Symphoricarpus, Diervilla, Rosa, Amelanchier,* but they rarely give character to an area of considerable extent. On heaths in the close vicinity of the Lake Shore, *Juniperus alpinus* is a very characteristic shrub.

The thickets found in the neighborhood of Milwauke are not always, nor perhaps even commonly, developed from the *Poa* heath formation. Where the exposure of the slope from which the forest is removed is towards the north or east, so that the insolation is comparatively small, the forest litter does not disap-

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1. Bulletin Wis. Nat'l Hist. Soc., Vol. I, page 183.

2. It is a remarkable fact that these two species hardly ever intermingle. *Rh. glabra* seems to be a little less xerophilous than its cousin.

pear so rapidly as in southerly and westerly exposures. Consequently the mesophytic herbs, the asters, sunflowers, golden rods, hold their ground much longer; the grasses do not make so much headway, and often other species of the family, which do not make so dense a sward as *Poa,* are more strongly represented than that genus. The hawthorns, hazelnuts and sumachs have strong competitors in the witch hazel, choke-cherry, prickly ash and others. Where there is a small spring on the hillside, as is very often the case, so that the soil for a few square rods is kept in swampy condition, *Sambucus nigra* is sure to be on hand, while willows and dogwood are very apt to stray up from the valley. The trees from the neighboring forest are sure to join in the race. Generally speaking, the conditions on such northerly slopes are so much more favorable to plant life than those on southerly exposures, that the mesophytic nature of the locality is really never lost. After the trees are cut down, there come a few years during which the ground is mostly bare except for the forest litter and such herbs and grasses as may have occupied the forest floor and continue to flourish in the clearing. Some of the latter will not survive more than a season or two under the changed conditions, but others which delight in the rich, loose soil, but could not tolerate the shade of the trees, will come in. Various species of *Rubus* are sure to grow luxuriantly, and their tangled vines are about the only impediment to the growth of the shrub and tree seedlings. Compared to the many years it takes the forest to reconquer a *Poa* heath, the progress of an area of this sort towards the forest stage is very rapid. The years before a thicket is formed are so few that one can hardly speak of a heath stage. In thickets of this kind the witch hazel is usually so much more abundant than the other shrubs mentioned, that one may properly call this the witch hazel, in distinction from the hawthorn association.

Either of the two species of *Rhus* mentioned above is likely to be met with in both of the two associations just described. But in a few places near the lake shore there are thickets in which *Rhus typhina* is dominant to such an extent that one must properly distinguish them as the Sumach Association. The staghorn sumach seems to have a peculiar liking for the steep, barren clay banks or bluffs along Lake Michigan. It invades them from above, establishing itself first on the upper edge of the bluff and sending root suckers down the almost vertical bank. The beginnings of this operation can be seen in many places all along the Lake. But in several places near Fox Point this enterprising shrub has in this manner conquered the whole bank from top to bottom for many rods.

Another remarkable occurrence of the sumach association is found near the southeastern corner of the county, within a few rods of the shore. Here it covers an area of several acres on a knoll composed of large crystalline boulders with but scanty soil between. The dominant shrubs are old and tall, and while they stand close together, their thin crowns shade the ground but lightly, so that the floor shows the typical heath vegetation of *Poa, Antennaria,* etc. The most interesting fact is that among the sumach grow numerous young witch hazels. These are as yet over-topped by the sumach almost everywhere, but are growing vigorously. It will be interesting to see whether the witch hazel, by reason of greater shade tolerance, will not gradually drive out the sumach and with it the xerophilous floor vegetation, so as in the end to convert this typically xerophytic thicket into a mesophytic one.

Small thickets are occasionally met with, sometimes covering several square rods, which are composed exclusively of a single species. One of the small trees or shrubs which has a tendency to form pure growths is the crab apple. Such crab apple thickets within which not a single foreign shrub is seen, though many other species may occur in the neighborhood, are found in various places along the bluffs of the Menomonee Valley. Another kind of pure growth is sometimes formed by the aspens (both *Populus tremuloides* and *grandidentata*). These species (although not uncommon and growing more frequent if the large proportion of young plants is evidence thereof) do not form a conspicuous feature of the plant life of the Milwaukee region. Where they do occur they usually assume their normal tree form, while farther inland, notably along the Kettle Range in Waukesha County, brush woods composed of aspen shrubs are numerous. Here and there, however, in our territory thickets of aspen are found. In these cases they consist of shoots springing from root suckers that proceed in more or less circular form from the mother plant in the middle. The latter can usually be distinguished easily by its somewhat greater height and trunk diameter, although it never grows to be a tall tree.

Very puzzling is the existence of thickets in one or two places, composed prevalently of *Ptelea trifoliata.* This shrub is found exclusively in the Menomonee Valley and the adjacent bluffs. Here it is exceedingly common, occupying stations of great variety, from those decidedly dry to those which are almost swampy. Nowhere else in this region has it ever been found, to my knowledge, but within its province it propagates freely. It bears seed abundantly year after year, and its seedlings are found of every age. Usually it mingles freely with other species, but occasionally it forms almost pure growths of small extent.

A form of brushwood that has many points of interest are the fence-rows. These straggling and interrupted growths are distinguished for the great variety of species occurring in them. All the upland shrubs of the region, from the xerophilous hawthorns and sumachs to the decidedly mesophytic species of *Ribes* are mingling in this formation, without any apparent distinction, of various associations. With the uplands species are commonly found *Vitis, Ampelopsis* and similar creepers, that are more often found in the bottom lands, and occasionally a dogwood flourishes in such places far away from its swamp. As to what may be the cause of the comprehensiveness of this fence-row vegetation, I have no theory to offer.

4. List of Plants collected on the Door County Peninsula, Wisconsin. (1)

The following plants were collected by the writer on two short trips to various portions of the Green Bay peninsula, during the summer of 1897:

a. In the upland woods, generally mesophytic localities:

1. *Botrychium virginianum (L.) Sudw.,* Baileys Harbor, Eagle Bay.

3. *Onoclea sensibilis L.,* Baileys Harbor, near Kangaroo Lake.

5. *Pteris aquilina L.,* very common everywhere on the uplands.

12. *Unifolium Canadense (Duf.) Greene,* Egg Harbor.
27. *Rubus parviflorus Nutt.,* Baileys Harbor, Eagle Bay.
29. *Geum canadense Jacq.,* common everywhere.
35. *Viola canadensis, L.,* Egg Harbor.
36, 37. *Viola rostrata, Pursh.,* Egg Harbor.
38. *Viola obliqua, Hill.,* Egg Harbor.
39. *Lepargyraea canadense L., Greene.* Common everywhere.
41. *Circaea alpina L.,* Lake Kangaroo, Eagle Bay.
44. *Pyrola rotundifolia L.,* Eagle Bay.
45. *Pyrola secunda L.,* Eagle Bay.
52. *Prunella vulgaris L.,* common throughout.
53. *Monarda fistulosa L.* (!).
56. *Diervilla diervilla (L.) MacM.,* Baileys Harbor.

b. In the xerophytic woodlands on the shore flats.
11. *Lilium Philadelphicum L.,* Eagle Bay, Strawberry Island.
14. *Cypripedium hirsutum Mill.,* Egg Harbor.
18, 19. *Anemone canadensis L.,* Fish Creek.

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1. Cf. "Notes from the Green Bay Peninsula," Bull. Wis. Nat. Hist. Soc., I, April, 1900.

25. *Adlumia fungosa (Ait.) Greene,* Fish Creek.
26. *Sophia pinnata (Walb.) Britton,* Egg Harbor.
54. *Castilleia coccinea (L.) Spreng.,* Strawberry Island (occurs also at Eagle Bay).
57. *Lobelia spicata Lam.,* Strawberry Island.

c. On the ridge along the west shore, north of Sturgeon Bay. Pinery, until cut over some years ago; xerophytic.

5. *Pteris aquilina L.*
32. *Polygala paucifolia Willd.,* Little Harbor.
55. *Pedicularis canadensis L.,* Little Harbor.

d. A large part of the shore flats and the slopes leading to the uplands at Fish Creek and Egg Harbor has been cleared and become xerophytic pasture or heath. Among the species occurring here are:

61. *Achillea millefolium L.,* Fish Creek.
59, 60. *Rudbeckia hirta L.,* Fish Creek.
58. *Antennaria neo-dioica Greene,* Fish Creek.
49. *Lappula lappula (L.) Karst.,* common.
50. *Verbena hastata L.,* Fish Creek.
10. *Poa annua L.,* the grass forming the body of these heaths. (1)
15. *Blitum capitatum L.,* Fish Creek.

e. In some places, depressions in the heath show more mesophytic conditions, graduating even into marshy places. Here were found:

13. *Iris versicolor L.,* Fish Creek.
21. *Ranunculus reptans intermedius Hook.,* Fish Creek.
22. *Ranunculus sceleratus L.,* Fish Creek.
23. *Ranunculus acris L.,* Fish Creek.
51. *Scutellaria lateriflora L.,* Fish Creek.

f. At Fish Creek, a brook empties into the bay. At its mouth, it broadens into a sluggish estuary. Along its course, especially towards the mouth, there is a marshy meadow. These hydrophytic stations show:

6. *Potamogeton alpinus Balbis.*
7. *Alisma plantago aquatica L.*
8. *Sagittaria latifolia Willd.*
9. *Briza media L.*
16. *Nymphaea advena Soland.*

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1. ***Juniperus alpina*, with its characteristic round clumps, is very characteristic of these heaths.**

20. *Ranunculus delphinifolius Torr.*
24. *Roripa nasturtium (L.) Rusby.*
30. *Geum virginianum L.*
34. *Hypericum prolificum L.*
42. *Cicuta bulbifera L.*
43. *Cornus candidissima Marsh.*
47. *Steironema quadriflorum Hitchc.*

g. On the ledges of Limestone rock were found:
4. *Cystopteris bulbifera (L.) Bernh.*, Fish Creek.
17. *Aquilegia canadensis L.*, Egg Harbor.
31. *Geranium robertianum L.*, Baileys Harbor.

h. On the sandy beach:
28. *Potentilla anserina L.*, Fish Creek.
46. *Primula mistassinica Michx.*, Egg Harbor.

i. On cultivated lands:
58. *Erigeron annuus (L.) Pers.*, Fish Creek.
62. *Crysanthemum leucanthemum L.*, Fish Creek.
40. *Chamaerion angustifolium (L.) Scop.*, Fish Creek.
33. *Malva moschata L.*, Baileys Harbor.

The specimens collected as above are now in the herbarium of the Public Museum of Milwaukee. The determination of the species is mostly the work of Miss Olive Wheeler of the Museum. The numbers refer to the original list in possession of the writer.

5. Forests and Brush Lands of Northern Waukesha County, Wisconsin.

The following observations refer more particularly to that part of Waukesha County lying north of the line of the Chicago & Northwestern Railway, which divides the county into two almost equal parts. It comprises therefore most of the Lake Region and the country to the east of that. The extreme west, which is really a part of the Rock River Valley, is omitted. There is no reason to believe that the southern half of the county is materially different in botanical or forestal character.

The physiography of the eastern part of the district is essentially alike to the western half of Milwaukee County: Rolling country with a subsoil of boulder clay, which allows but very few outcrops of the underlying limestone rock. Many of the gravel hills are drumloid in character, others irregular in shape. The western half is characterized by the great accumulation of morainic hills and ridges, with corresponding depressions, which is popularly known as the Kettle Range. The highest elevation of this part of the Range is Government Hill, south of Delafield, the top of which is 368 feet over Lake Nagawicka, and 669 feet above Lake Michigan. Accompanying the moraine, and lying in part within its very center, are the numerous lakes of sizes varying from a few acres to several square miles, which have given this region fame as a summer resort. Another marked physiographical feature are the many broad, level depressions, most of them evidently old lake beds. Usually there is a small river or brook of sluggish current flowing through them. Some areas of this kind have been turned into tilled fields, but the larger portion is occupied by rather moist meadows, which in many places become pronounced sedge marshes.

The forest of that part of this district lying east of the Kettle Range is on the whole similar to that of western Milwaukee County (see Bull. Wis. Natural Hist. Soc., January, 1902), except that as you proceed westward the areas in which hard maple, basswood and associated trees prevail, become rarer, and the oaks correspondingly more numerous. In other words, the mesophytic forest type, with its deep and rich humus and dense shade, gives way to the hemixerophytic oak forest, with its lighter shade and comparatively thin layer of humus. In the moist depressions, a hemi-hydrophytic association, in which the American elm is the most conspicuous member, appears just as in Milwaukee County, while portions of the larger bottoms are covered with tamarack swamps, although much of this class of land has been converted into tilled fields.

Within the oak forests, the burr oak, the most xerophytic of the group, becomes decidedly more numerous the farther west one goes.

While the eastern half of the district may still fairly be classed with Chamberlain's Oak and Maple Group (See T. C. Chamberlain, Report of Wisconsin Geological Survey, Vol. II., Chapter III.), the moment one has reached the Kettle Range, he is decidedly in the region of oak forests. Maple, basswood, butternut and white ash are practically absent. With the oaks (*Qu. alba, macrocarpa, obtusiloba, rubra* and *velutina*) are found *Hicoria ovata Britton* and occasionally *H. glabra Britton. Prunus serotina* is not uncommon, and sometimes grows to great dimensions. *Populus tremuloides* and to a less degree *P. grandidentata* are not at all infrequent, although they are more characteristic of the brush lands to be described forthwith. In tree-form, these two species seem to prefer situations that are not too dry, as for instance at the bottom of a slope, the higher portions of which are left in the possession of the oaks.

In the Kettle Range the traveler coming from Lake Michigan meets for the first time with *Juniperus virginiana.* The red cedar trees are nearly all comparatively young, and usually occupy places where the oak forest has been removed and a heath taken its place. In this region, also, the first traces of the peculiar formation locally known as "openings," are met with. These savanna-like areas are, or were before settlement, very conspicuous features of the Rock River Valley and the territory to the west and south. An area of this kind of small extent, is found on the east side of Lower Nemahbin Lake. On a steep slope with western exposures grow about fifty old burr oaks. None are higher than twenty feet, those at the uppermost places being the smallest. Their average diameters are about twelve inches. They branch very low and have broad, spreading crowns. Notwithstanding their small size it is evident from their bark and general appearance that they are very old. They stand so far apart that their branches do not touch. The ground is covered with a dense sward of *Poa,* which in 1901 had the upper third of the slope exclusively to itself, aside from a few insignificant patches of a small moss that is usually found on *Poa* heaths. Farther down hill, there were colonies of *Antennaria plantaginifolia* and *Hedeoma pulegioides.* The latter was most conspicuous in spots where dry leaves had accumulated and driven off the grass. Here were also a few seedlings of *Populus tremuloides* and *Juniperus virginiana.* At the foot of the hill, immediately on the water's edge, there are a few basswood and American elm trees, with several seedlings. The northern slope of this hill has instead of the opening the hemixerophytic thicket commonly found in similar localities. The opening here described is not a typical one. Usually the oaks are of considerable size, while here they show decided dwarfishness. Apparently the steepness of the slope together with the westerly exposure, which cause long and powerful insolation, have made the conditions of life exceedingly hard here. But the arrival of seedlings of aspen and cedar undoubtedly foreshadows the future conversion of even this unfavorable locality into a thicket such as is found on the north side of the hill.

Like all of the southeastern portions of Wisconsin, the district under discussion shows very great traces of the influence of man. The almost continuous forest originally covering the land has been cleared away, until now only isolated patches remain. The hilly character of the Kettle Range country has preserved a larger portion of that part of the territory under forest cover than is the case towards the east. But even here many steep slopes, quite unfit for agriculture, have been denuded. On such slopes a succession of formations takes place, very similar to the history of like areas in Milwaukee County as described above, yet differing in many details, agreeably to the more xerophytic character of the flora.

In many places, the forest has given way altogether to a *Poa* heath. This is probably the normal case whenever the tree cover is entirely removed, unless there is an opportunity for coppice growth. The latter is more or less of an accident, as the small farmers who own the land rarely regulate their cutting with this end in view. Mesophytic thickets of witch hazel and its associates, such as are common farther east, seem to be absent in Waukesha County. Even north and east exposures become *Poa* heaths with hemixerophytic shrubs, and the only difference between them and south or west slopes seems to be, that in the latter the progress from heath to thicket is a little faster.

Among the shrubs that are most conspicuous in the early stages of a heath are hazelnut, several species of hawthorn, and the staghorn sumach. Later come choke cherries, wild plums, and crab apple. On the Kettle Range, clumps of red cedar are a prominent feature of these localities. They do not seem to be able to thrive in thickets, however, and therefore disappear, when the later stages are reached. The trembling aspen takes little part in the early development of a heath. But by the time the various groups of hawthorn and hazel begin to run together, it appears and multiplies very rapidly; often it drives out its predecessors. The aspen is enabled to do so, because it spreads by root suckers; plants that send out many of these, remain shrubby instead of assuming tree form like their brethren in the forest. After a thicket of this kind has grown to be rather dense, a considerable accumulation of humus may take place and much more mesophytic conditions be produced. This shows itself at once in the character of the herbs covering the soil.

As long as the heath character is still pronounced, few foreign species are found in the *Poa* sward. Among these few are *Ranunculus fascicularis, Viola pedata* (apparently not found east of the Kettle Range), *Verbascum thapsus, Antennaria plantaginifolia,* and the ever-present dandelion. The incipient thickets harbor *Viola sororia, Anemone nemorosa, Anemone nuttalliana, Fragaria.* When the thicket becomes quite dense, one may find *Viola obliqua, Ranunculus abortivus, Hepatica, Podophyllum peltatum,* and now and then even so distinctively a mesophytic herb as *Trillium grandiflorum.* By the time this stage is reached, numerous young oaks, hickories and black cherries have usually appeared, which gradually overtop the shrubs, so that the latter thereafter form the underwood in an oak forest. It appears, therefore, that the most mesophytic stations in this region are not the forests, but the thickets which precede them.

As a rule the reclaiming of a heath begins at the foot of a hill, so that the lower portion may already show young oak forest, while the top is still typical *Poa* heath. Sometimes it happens that the top of the hill is broad and level. It may be either a tilled field or a forest. In either case the top may form a base of attack for the invading shrubs (in case of a field, there is usually a fence-row, from which they may spread), so that a thicket may form both at the foot and the top of the slope, while the middle portion is still grassland.

Mesophytic stations, such as are afforded by the maple-basswood forests in Milwaukee County, are rather rare in Waukesha. Consequently the species characteristic of such localities do not form a conspicuous feature of the flora. Such plants as *Erythronium Americanum, Viola pubescens, Trillium grandiflorum,* and other herbs with very few or no xerophytic adaptations are most apt to be found here in moist depressions, where the elm is the significant tree. *Podophyllum peltatum* has already been mentioned as occurring in the older portions of the thickets described. It is rare in the oak forests, except in places where very dense underbrush has allowed unusually rich humus to accumulate. It is quite common, on the other hand, along fence rows, which here as in Milwaukee County are distinguished by a remarkably comprehensive flora. A very interesting occurrence of *Podophyllum* is sometimes found in deep and narrow "kettles," where the forest has been cleared or strongly thinned. Here one can sometimes find the floor generally covered with grass. In the bottom is an accumulation of dry leaves which prevents the grass from growing. Here are numerous plants of *Podophyllum,* which also spreads about half way up the southern slope. On the opposite side of the kettle, which receives the noon-day sunshine, not a single mandrake will be seen, but instead there grow among the grass colonies of such xerophytic plants as *Antennaria* and *Viola sororia.*

On the whole, it is apparent, that the oak forest has a fair prospect of returning to the places from which it was removed, when the cycle of heath and thicket is complete. Here and there, however, one may observe very dense and old thickets, in which the trees are quite absent. This is especially so, where the crab apple is the predominant species. As the oak is decidedly intolerant of shade, it may be that the thicket in such cases is too dense to allow seedlings to grow up. Another reason, of course, may be simply the absence of seed, as the heavy fruits of oaks and hickories do not travel far. One might conceive a case, under such circumstances, where basswood and maple might find a place under the shrubs, as they are certainly tolerant enough of shade to prosper in such places. Then the thicket would be followed directly by the culmination type of forest. No actual case of this kind has, however, been observed, so far. Generally speaking, the advent of man has made it more difficult, rather than otherwise, for the forest of the region to progress to its culmination in the maple-basswood-beech association, for reasons given at length in the paper on Milwaukee County.

6. Eastern Wisconsin Plants from the Herbarium of the Milwaukee Public Museum.

The herbarium of the Public Museum of the City of Milwaukee contains some excellent material, and with proper attention may in the future grow into a collection of considerable value. It now numbers over 10,000 sheets, and is divided into Wisconsin, United States and foreign (mostly Central European) material. Aside from a collection of mosses, mostly from Europe, only the Spermatophytes and Pteridophytes are represented. (Within the last two years, a collection of fungi has been started and is rapidly growing).

The Wisconsin department, as, in fact, practically the whole herbarium, has grown up, as it were, by accident. That is, various private collectors have from time to time contributed material. This has been arranged simply by placing each sheet in its proper genus cover. The Wisconsin genera lie in their case according to families, but for the rest of the collection, even so much has not yet been done. As might be expected under these circumstances, the herbarium shows great gaps; as is usual with amateur collectors, the most common and characteristic species of a given locality are often absent, while there is a fair proportion of "rarities." The determinations have usually been made by the collectors themselves, and as a result great confusion exists regarding the nomenclature, in which, however, Gray's Manual seems to have been followed most often. Unfortunately some of the collectors have deemed it unnecessary to add the authority for the name given to a plant, which increases the confusion. In the following list no attempt is made to reduce the nomenclature to a modern standard, but the name is reproduced as found on the specimen sheet. The determinations seem to be correct, on the whole. There may be some errors, especially in the more difficult genera and families, but not enough to impair the value of the following list, such as it is. Another unfortunate defect in the herbarium is the scantiness of the field notes, which made it quite impossible to attempt a classification of the species according to the character of their habitat.

The question may arise whether it is worth while to publish such fragmentary lists as are given below. The answer is that so very little is known regarding the local distribution of Wisconsin plants (1) that even the scantiest data are a help to the student. It is devoutly to be wished that a more systematic study may soon be undertaken by competent authority, so that such work as this may be entirely superseded.

The majority of the plants in the Milwaukee herbarium come from Milwaukee county. Of these full lists have already been published. There are some sheets with plants coming from many scattered parts of the state, but not enough from any one locality to make a useful list. These have been omitted. The lists printed below refer therefore to portions of Eastern Wisconsin, *i. e.*, that part lying between Lake Michigan on the east and the Fox-Rock River Valley on the west. The only exception is the list referring to the vicinity of the Dells of the Wisconsin, which is in the central portion of the state.

The numbers added are the regular accession numbers of the Milwaukee herbarium.

A. JEFFERSON COUNTY.

The region covered by this list lies in the broad valley of the Rock River. It was originally debatable ground between oak forest, opening and prairie, with large stretches of sedge marsh and tamarack swamp. At present most of the area is under cultivation or in pasture. There are numerous brooks and a large body of water known as Lake Koshkonong, besides smaller lakes and ponds.

The plants in this list were collected by T. Kumlien, unless otherwise noted. Mr. Kumlien's work was mostly done forty and more years ago, so that some of his species have probably disappeared from the locality.

1230. Pellaea atropurpurea Gr.
1047. Naias flexilis Rost.
7062. Scheuchzeria palustris L.
1063. Triglochin maritimun elatum.
1064. Alisma plantago americanum (dwarf specimens).
931. Vallisneria spiralis L.
1171. Panicum capillare L. (?)
1129. Bouteloua curtipendula Gray.
1106. Cyperus filiculmis Vahl.

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1. See L. S. Cheney, Historical Review of Work Done on the Flora of the Territory now Included in the Limits of Wisconsin. Pharmaceutical Review, Vol. XVIII, 12; XIX, 1.

1098. Cyperus diandrus var. castaneus Torr.
1100. Cyperus Michauxianus Schultes.
1101. Cyperus Engelmanni Stend.
1105. Cyperus inflexus Muhl.
1108. Eleocharis obtusa Schultes.
1119. Scirpus americanus Pers.
1111. Eriophorum virginicum L.
961. Liparis liliifolia Richard.
933. Calopogon pulchellus R. Br.
870. Betula pumila L.
863. Alnus incana Willd. (?)
850. Pilea pumila Gray.
826. Asarum Canadense L.
52. Nelumbium luteum Willd. (In lake between Busseyville and Albion, Dane County, 1850).
12. Coptis trifolia Salisb.
7. Hepatica triloba Chaix.
65. Dicentra cucullaria D. C.
63. Corydalis aurea Willd.
68. Arabis dentata Torr. and Gray.
79. Draba Caroliniana Walt.
302. Drosera rotundifolia L.
303. Drosera linearis Goldie.
244. Geum triflorum Pursh.
185. Amorpha fruticosa L.
205. Lathyrus palustris L.
1114. Hemicarpha micrantha Vahl.
1116. Rhynchospora alba Vahl.
1083. Carex limosa L.
1087. Carex stellulata
1025. Juncus tenuis Willd.
1028. Luzula pilosa Willd.
1042. Lemna trisulca L. (?)
1043. Lemna polyrhiza L. (?)
1013. Pontederia cordata L.
1015. Schollera dubia.
914. Cypripedium candidum, Muhl.
954. Platanthera flava Gray.
955. Platanthera leucophaea, Nutt.
957. Habenaria lacera R. Br.
965. Pogonia ophioglossoides Nutt.
966. Pogonia pendula, Lindl.
932. Arethusa bulbosa L.
945. Goodyera pubescens R. Br.
962. Microstylis ophioglossoides, Nutt.

108. Polygala verticillata L.
103. Polygala incarnata L. (1)
104. Polygala sanguinea L.
105. Polygala cruciata L.
832. Acalypha virginica L.
183. Rhus venenata D. C.
134. Hypericum mutilum S.
95. Viola sagittata Ait.
315. Epilobium lineare Muhl.
316. Epilobium molle Torr.
320. Oenothera pumila L.
306. Hippuris vulgaris L.
600. Cassandra calyculata Dow.
648. Gentiana puberula Michx.
655. Ellisia Nyctelia L.
737. Verbena stricta Vent.
739. Verbena bracteosa Michx.
731. Lippia lanceolata Michx.
750. Lophanthus nepetoides Benth.
716. Verbascum blattaria L.
702. Mimulus Jamesii Torr. and Gray.
697. Ilysanthes gratioloides Benth.
713. Synthyris Houghtoniana Benth.
696. Gerardia quercifolia Pursh.
695. Gerardia tenuifolia Vahl.
727. Utricularia vulgaris L.
229. Utricularia clandestina Nutt. (?)
403. Valeriana ciliata Torr. and Gray. (2)
522. Hieracium canadense Michx.
525. Kuhnia eupatorioides L.
533. Liatris cylindracea Michx.
9957. Solidago neglecta (C. E. Monroe.)
9242. Solidago rigidiuscula (C. E. Monroe.)
9224. Solidago nemoralis (Monroe.)
9229 Solidago Canadensis (Monroe.)
490. Erigeron bellidifolium Muhl.
494. Erigeron strigosum Muhl.
493. Erigeron annuum Pers.
425. Diplopappus linariifolius Hook.
552. Silphium integrifolium Michx.
9320. Aster longifolius (Monroe.)
9315. Aster novi-Belgii (Monroe).

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1. Date 1860; marked "now exterminated."

2. Date 1856; marked "long since extinct in that locality," (one mile west of Busseyville).

9336. Aster laevis (Monroe).
9321. Aster paniculatus (Monroe).
9305. Ionactis linariifolius (Monroe).
456. Aster amethystinum Nutt.
457. Aster oblongifolius Nutt.
9361. Aster sericeus (Monroe).
518. Helianthus hirsutus Raf.

B. WAUKESHA COUNTY.

The plants listed from this county are all derived either from the "Lake Region," which includes the gravel hills of the Kettle Range, or the rolling country to the east of the latter. The area was, therefore, mostly wooded before settlement, with but few and inconsiderable prairies.

The specimens were collected by C. E. Monroe, unless otherwise noted (1):

Panicum porterianum Nash. A. Conrath.
1157. Koeleria cristata Pers. Conrath.
1152. Glyceria nervata Trinius. Conrath.
1074. Carex intumescens Rudge. Conrath.
967. Spiranthes cernua Rich. Conrath.
9667. Polygonum dumetorum.
9403. Ranunculus trichophyllus. Nagawicka.
9404. Ranunculus Pennsylvanicus.
9415. Lepidium Virginicum.
301. Drosera rotundifolia L. (?) W. M. Wheeler.
284. Heuchera hispida Pursh. Conrath.
9874. Spiraea salicifolia.
9880. Rubus Canadensis L.
9889. Potentilla norwegica.
253. Potentilla fruticosa L., Genesee. W. M. Wheeler.
255. Potentilla palustris Scapoli. Conrath.
189. Apios tuberosa Moench. W. M. Wheeler.
9454. Rhus hirta Sudw. Conrath.
9119. Apocynum cannabinum.
1054. Potamogeton compressus L. Conrath.

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1. Mr. Bruncken's complaint of unnecessary confusion caused by the omission of the authorities from these names is only partly justified. When my private collection was turned over to the Public Museum some six years ago it was with the statement that the names and their authors were those found in the Revised Edition of Gray's Manual of Botany of 1890. The names given in the foregoing list and in the following lists of plants from Racine County and the Dells of the Wisconsin do not seem to be in all cases those which were written upon the original sheets, some revision having apparently been made after the publication of Britton & Brown's work on the Flora of the United States. In addition to the specimens collected and donated to the Public Museum a large number of Species are listed in my note books from localities in Waukesha and Racine Counties and the Dells of the Wisconsin.—CHARLES E. MONROE.

1055. Potamogeton praelongus Wulf. Conrath.
1052. Potamogeton pusillus L. Conrath.
1123. Agrostis perennis Tuckerm. Conrath.
1181. Poa alsodes Gray.
1151. Glyceria elongata R. Br.
..... Juncus tenuis Willd.
9663. Corallorhiza multiflora.
809. Polygonum amphibium L.
9684. Polygonum Careyi. New Berlin.
9669. Polygonum dumetorum.
9698. Polygonum lapathifolium.
9680. Polygonum persicaria.
9696. Polygonum aviculare.
51. Brasenia purpurea Casp. Muskego Lake, Bruhin.
9390. Clematis virginiana.
9405. Ranunculus Pennsylvanicus.
9465. Trifolium hybridum.
212. Petalostemon violaceum Michx. W. M. Wheeler.
9432. Desmodium nudiflorum.
9707. Euphorbia corollata.
9449. Ceanothus americana.
9433. Hypericum maculatum.
9432. Hypericum perforatum.
9431. Hypericum Ascyron.
9438. Triadenum Virginicum Raf.
9926. Isnardia palustris.
9925. Ludwigia polycarpa.
9929. Epilobium coloratum.
9935. Epilobium adenocaulum.
9103. Asclepias tuberosa.
9109. Asclepias cornuti.
9106. Asclepias purpuraceus.
9208. Calystegia saepium.
653. Phlox pilosa L.
9214. Echinospermum Lappula.
9215. Echinospermum virginicum.
9162. Verbena hastata.
9137. Scutellaria versicolor.
9135. Scutellaria lateriflora.
9139. Lophanthus scrofulariaefolius.
9138. Nepeta cataria.
9133. Prunella vulgaris L.
9131. Stachys palustris.
741. Blephilia ciliata Raf. Conrath.
9142. Hedeoma pulegioides.

769. Pycnanthemum lanceolatum Pursh. Runge.
9194. Lycopus virginicus.
9152. Mentha Americana.
685. Physalis Pennsylvanica L. Conrath.
9201. Scrophularia nodosa.
9180. Gerardia purpurea paupercula.
9181. Gerardia purpurea.
9157. Phryna leptostachya.
9042. Cephalanthus occidentalis.
9046. Galium boreale.
9038. Symphoricarpus racemosus.
9076. Campanula Americana.
9073. Campanula rotundifolia.
9057. Lobelia Cardinalis.
9069. Lobelia Kalmii.
10118. Lactuca canadensis.
10014. Eupatorium perfoliatum.
10012. Eupatorium purpureum.
10023. Liatris scariosa.
532. Liatris cylindracea. W. M. Wheeler.
9243. Solidago Missouriensis.
9957. Solidago rigida.
9961. Solidago neglecta.
9990. Solidago serotina.
10058. Heliopsis scabra.
10057. Heliopsis helianthoides.
10053. Silphium perfoliatum.
10046. Polymnia canadensis.
10043. Inula Helenium.
10041. Gnaphalium polycephalum.
9317. Aster junceus.
10061. Rudbeckia laciniata.
10075. Lepachys columnaris.
10070. Lepachys pinnata.
10076. Coreopsis palmata.
458. Bidens cernua L. (var. ?). W. M. Wheeler, Muskego Lake.

C. TWO RIVERS.

There is a considerable collection from the neighborhood of Two Rivers, Manitowoc County, contributed by Prof. Emil Dapprich, unless another name is given.

7711. Equisetum scirpoides Michx. E. Dapprich.
7963. Potamogeton compressus L. E. Dapprich.
7967. Potamogeton pusillus L. E. Dapprich.

7966. Potamogeton pauciflorus Pursh. E. Dapprich.
8036. Potamogeton pectinatus L. E. Dapprich.
7964. Potamogeton natans L. E. Dapprich.
7960. Potamogeton praelongus Wulf. E. Dapprich.
7961. Potamogeton heterophyllus Fries. E. Dapprich.
7971. Zostera marina L. E. Dapprich.
8035. Triglochin palustre L. E. Dapprich.
8026. Sagittaria variabilis gracilis Eng. E. Dapprich.
8032. Sagittaria heterophylla Pursh.
8025. Anacharis Canadensis Planch.
8339. Deyeuxia confinis Kunth.
8135. Juncus Balticus Dethard.
8136. Juncus filiformis L.
1005. Tofieldia glutinosa Willd. Th. Kumlien.
8022. Calla palustris L.
8152. Clintonia borealis Raf.
8151. Smilacina stellata Desf.
8155. Trillium erectum album Pursh.
8119. Habenaria obtusata Richards.
8112. Microstylis monophyllos Lindl.
8110. Liparis Loeselii Richard.
6823. Myrica Gale L.
7053. Populus balsamifera candicans Gray.
6817. Betula pumila L.
6815. Betula lutea.
6816. Betula papyracea Ait.
6818. Alnus incana Willd.
7037. Polygonum erectum L.
7178. Stellaria longipes Goldie.
8185. Arenaria stricta Watson.
6573. Nymphaea tuberosa Paine.
6796. Ceratophyllum echinatum.
6592. Ranunculus Cymbalaria Pursh.
6539. Ranunculus Pennsylvanicus L. F.
26. Ranunculus ovalis Raf.
29. Ranunculus Pennsylvanicus L. F.
30. Ranunculus fascicularis Muhl.
67. Arabis lyrata L. Kumlein.
6610. Dentaria maxima Nutt.
6606. Cardamine pratensis L.
6596. Brassica campestris L.
6566. Cakile Americana L.
6565. Cakile maritima Scop.
6572. Sarracenia purpurea L.
7736. Chrysosplenium Americanum Schw.

7734. Sedum acre L.
7742. Ribes gracile Michx.
7743. Ribes floridum L'Her.
7744. Ribes prostratum L'Her.
7548. Rubus Canadensis L.
7530. Potentilla palustris Scop.
7558. Prunus pumila L.
6898. Lupinus Nootkaensis Donn.
7157. Polygala paucifolia L.
7297. Euphorbia polygonifolia L.
7306. Euphorbia glyptosperma Englm.
8330. Callitriche verna L.
8329. Callitriche terrestris.
7192. Ilex glabra Gray.
7140. Acer spicatum Lam.
7112. Hypericum ellipticum Hook.
7591. Epilobium palustre albiflorum.
7574. Proserpinaca palustris L.
351. Aralia spinosa L. Kumlien.
7682. Cornus stolonifera Michx.
7395. Pyrola asarifolia Hook.
7384. Vaccinium Pennsylvanicum Lam.
8232. Vaccinium Oxycoccus L.
7382. Arctostaphylos Uva-ursi L.
604. Epigaea repens L. Kumlien.
7387. Andromeda polifolia L.
7388. Cassandra calyculata Don.
7380. Chiogenes hispidula T. and G.
617. Androsace occidentalis Pursh. (?) Kumlien.
7408. Lysimachia nummularia L.
7276. Gentiana Andrewsii Griseb.
7271. Halenia deflexa Griseb.
7482. Menyanthes trifoliata L.
7882. Phacelia Franklinii Gray.
7791. Stachys aspera Michx.
7405. Utricularia intermedia Hayne.
7997. Galium asprellum Michx.
7996. Galium boreale L.
7995. Galium triflorum Michx.
7994. Galium trifidum L.
7974. Viburnum Opulus L.
7983. Symphoricarpus vulgaris Michx.
7980. Symphoricarpus occidentalis Michx.
7979. Lonicera hirsuta Eaton.
596. Campanula rotundifolia L.

7511. Hieracium Gronovii L.
7512. Hieracium Canadense Michx.
8224. Chrysocoma tomentosa Walt.
6222. Eupatorium maculatum Darl.
6984. Solidago hispida.
6217. Erigeron glabellus Nutt.
6727. Gnaphalium uliginosum L.
6202. Aster novi-Belgii praealtus Lam.
7219. Aster macrophyllus L.
7762. Hyssopus officinalis L.
6774. Helianthus scaberrimus Nutt.
6766. Coreopsis grandiflora Nutt.
6765. Coreopsis lanceolata L.
6792. Bidens Beckii Torr.
6735. Achillea ptarmica L.
7506. Cnicus Pitcheri Torr.
7503. Cnicus muticus Pursh.

D. RACINE COUNTY.

The following specimens, mostly from either the Town of Mount Pleasant or that of Yorkville, were contributed by C. E. Monroe, unless otherwise noted.

9614. Allium cernuum. Yorkville.
9626. Habenaria leucophaea. Yorkville.
9657. Gyrostachys cernua. Mount Pleasant.
9686. Polygonum Hartwrightii. Yorkville.
9679. Polygonum hydropiperoides. Mt. Pleasant.
9426. Silene stellata. Yorkville.
9424. Saponaria officinalis. Mt. Pleasant.
9392. Anemone cylindrica. Yorkville.
9397. Anemone virginiana. Yorkville.
9916. Heuchera hispida. Yorkville.
9514. Cassia chamaecrista. Yorkville.
9461. Baptisia leucophaea. Mt. Pleasant.
9468. Trifolium procumbens. Mt. Pleasant.
9470. Amorpha canescens. Yorkville.
9473. Kunistera candida. Yorkville.
9491. Desmodium Dillenii. Yorkville.
9499. Vicia americana linearis.
9502. Lathyrus palustris.
9459. Polygala viridescens. Mt. Pleasant.
9173. Gerardia tenuifolia.
9183. Gerardia purpurea. Mt. Pleasant.
9188. Gerardia auriculata. Mt. Pleasant.

9029. Sambucus Canadensis. Mt. Pleasant.
9062. Lobelia spicata.
10113. Prenanthes racemosa. Mt. Pleasant.
10031. Boltonia asterioides. Mt. Pleasant.
10025. Liatris scariosa. Mt. Pleasant.
10029. Liatris spicata. Yorkville.
..... Solidago Missouriensis. Mt. Pleasant.
9222. Solidago Ohioensis. Mt. Pleasant.
9221. Solidago Riddellii. Mt. Pleasant.
9954. Solidago rigida. Mt. Pleasant.
9231. Solidago serotina. Mt. Pleasant.
9225. Solidago nemoralis. Mt. Pleasant.
9997. Solidago canadensis. Mt. Pleasant.
9976. Solidago juncea. Mt. Pleasant.
10054. Parthenium integrifolium. Yorkville.
10051. Silphium integrifolium. Yorkville.
10050. Silphium terebinthinaceum. Yorkville.
9705. Euphorbia nutans.
9923. Lythrum alatum.
9869. Pastinaca sativa.
9854. Eryngium aquaticum. Yorkville.
9863 Berula erecta. Mt. Pleasant.
9865. Sium cicutaefolium. Mt. Pleasant.
9859. Zizia cordata.
9857. Cicuta maculata.
9127. Gentiana puberula. Mt. Pleasant.
9110. Asclepias Sullivantii.
9102. Asclepias tuberosa. Yorkville.
9115. Acerates viridiflora. Yorkville.
9114. Acerates longifolia. Yorkville.
9116. Acerates lanuginosa. Yorkville.
9218. Phlox pilosa.
9211. Lithospermum canescens.
9144. Pycnanthemum linifolium. Yorkville.
9146. Pycnanthemum lanceolatum. Yorkville.
9150. Mentha Canadensis. Yorkville.
10048. Silphium laciniatum. Yorkville.
9360. Aster novae-angliae. Mt. Pleasant.
9333. Aster multiformis. Mt. Pleasant.
9304. Aster ptarmicoides. Mt. Pleasant.
9367. Aster azureus. Mt. Pleasant.
10073. Lepachys pinnata. Yorkville.
9262. Helianthus Maximiliani. Mt. Pleasant.
10101. Cnicus altissimus. Yorkville.

E. PORT WASHINGTON.

The neighborhood of Port Washington, Ozaukee County, furnishes the following specimens, collected by F. Runge, unless stated otherwise:

1221. Struthiopteris Germanica Willd.
1219. Cystopteris bulbifera Berut.
1207. Aspidium spinulisum Swartz.
1231. Phegopteris Dryopteris Fee.
928. Pinus Strobus L.
921. Juniperus communis L.
866. Betula lenta Linn.
22. Ranunculus acris L.
299. Penthorum sedoides L. Cedarburg.
277. Spiraea salicifolia L. C. Doerflinger, Cedarburg.
249. Potentilla palustris Scop. C. Doerflinger, Cedarburg.
265. Rosa rubiginosa L. Cedarburg.
264. Rosa blanda Ait.
197. Desmodium Canadense D. C.
188. Amphicarpaea monoica Nutt.
6314. Acer spicatum Lan. Lake Shore.
138. Malva moschata L.
6309. Dirca palustris L.
828. Shepherdia Canadensis Nutt.
360. Cornus circinata L.
610. Pyrola chlorantha Schwart.
599. Arctostaphylos Uva-Ursi Spreng. Lake Shore.
772. Satureia hortensis L.
682. Lycium vulgare Dunal.
384. Viburnum dentatum L. Lake Shore.
366. Lonicera hirsuta Eaton.
527. Lactuca canadensis sanguinea T. and G.
556. Solidago serotina Ait. Lake Shore.
512. Helianthus giganteus L.
509. Helianthus mollis Lam.
417. Artemisia Absynthium L.

F. ELKHART LAKE.

Mr. A. Conrath has contributed the following small but interesting list, mostly from the tamarack swamps in the vicinity of Elkhart Lake, Sheboygan County:

923. Juniperus Virginiana L.
968. Spiranthes cernua Richard.
601. Chimaphila umbellata Nutt.
605. Gaultheria procumbens.

607. Ledum latifolium Ait.
602. Chiogenes hispidula Torr. and Gray.
770. Pycnanthemum pilosum Nutt.
593. Lobelia Kalmii L.
521. Hieracium canadense Michx.
447. Aster puniceus L.
444. Aster ptarmicoides T. and G.
424. Ionactis linariifolius.

G. CEDAR LAKE.

Cedar Lake in Washington County contributes the following by W. M. Wheeler:

6342. Equisetum limosum L.
6339. Corydalis glauca Pursh.
6343. Corallorhiza multiflora Nutt.
6340. Arabis Drummondi Gray. (?)
213. Petalostemon violaceum Michx. Conrath.
6344. Circaea alpina L.
6338. Pyrola secunda L.
9096. Monotropa uniflora L.

H. DELLS OF THE WISCONSIN.

Mr. C. E. Monroe contributes the following from the neighborhood of Kilbourn City and the Dells above and below that place:

9628. Habenaria Hookeriana.
9642. Limodorum tuberosum.
816. Polygonum Virginianum L.
9678. Polygonum hydropiper.
9412. Corydalis glauca.
9914. Sullivantia Sullivantii.
9892. Potentilla argentea.
9462. Baptisia leucantha.
9467. Trifolium hybridum.
9487. Desmodium acuminatum.
9481. Desmodium nudiflorum.
9457. Polygala viridescens.
9709. Euphorbia helioscopia.
9702. Euphorbia humistata. Portage.
9701. Euphorbia glyptosperma. Portage.
9435. Hypericum gymnanthum Engelm.
9437. Hypericum Canadense.
9422. Lechea minor.
9927. Epilobium lineare.

9936. Epilobium Hornemanni.
9944. Epilobium hirsutum.
9947. Kneiffia pumila.
9940. Onagra Oakesiana.
9943. Oenothera rhombipetala.
9080. Gaultheria procumbens.
9213. Echinospermum Lappula.
9212. Lithospermum hirtum.
9141. Monarda punctata.
9189. Gerardia grandiflora.
9191. Gerardia pedicularis.
9178. Gerardia tenuifolia.
526. Mulgedium leucophaeum D. C.
10107. Hieracium canadense.
10109. Hieracium scabrum.
10015. Eupatorium ageratoides.
10026. Liatris pycnostachya.
10024. Liatris scariosa.
10018. Liatris cylindracea.
9960. Solidago uliginosa.
9239. Solidago speciosa.
9245. Solidago hispida.
9996. Solidago Canadensis.
9223. Solidago juncea scabella.
9307. Doellingeria umbellata.
10042. Gnaphalium uliginosum.
9293. Helianthus giganteus.
9253. Helianthus occidentalis.
9263. Helianthus Maximiliani.
10090. Helenium autumnale.
10103. Cnicus muticus.

It may be permitted to add here a list of the ferns growing in or near the Dells according to Miss H. B. Merrill, as stated by her in a little pamphlet published by the Chicago, Milwaukee & St. Paul Railway Company: (1)

Adiantum pedatum.
Dryopteris cristata.
Dryopteris fragrans.
Dryopteris marginalis.
Dryopteris spinulosa.
Dryopteris Thelypteris.
Asplenium Filix-foemina.

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1. Ferns of the Dells of the Wisconsin at Kilbourn City, Wis., on the line of the Chicago, Milwaukee & St. Paul Railway Co. Published for the General Passenger Department.

Asplenium acrostichoides.
Asplenium Trichomanes.
Botrychium ternatum.
Botrychium Virginianum.
Camptosorus rhizophyllus.
Cystopteris bulbifera.
Cystopteris fragilis.

The most interesting of these ferns is Dryopteris fragrans, on account of its rarity, it being known to occur in but very few and widely separated places. This list is by no means complete.

7. A Tamarack Swamp in Waukesha County.

The little hamlet of Calhoun, on the Northwestern Railway, in the northern part of the town of New Berlin, Waukesha County, lies near the eastern extremity of one of those broad depressions, the beds of lakes within very recent times, which are so common in the eastern part of that county. The drainage of this depression, such as there is, goes towards the Fox River (of the Illinois). The width of the basin is about a mile, and the length from east to west about two miles. The central part of the basin constitutes a paludinal area, which ranges from places with open, shallow water and a flora dominated by *Typha,* through various grades of sedge marsh to mesophytic meadow land. The boundaries of these various zones are rather indefinite and vary from time to time, according as there is a succession of wet or dry seasons. They exhibit a wealth of *Cyperaceae, Gramineae* and other grass-like forms, and will richly repay a closer study, which, however, must be left to a future time.

Surrounding the grass area is an irregular, much interrupted belt of hydrophilous shrubbery. The dominant genus in this association is *Salix.* The most conspicuous species of willow is a form very similar to the typical *Salix sericea* of the Eastern states. Associated are *S. discolor, S. lucida, S. candida,* and probably several others, not to speak of hybrids. Mingled with the willows are several species of *Cornus, Spiraea salicifolia,* and in some places *Viburnum* (especially *V. Lentago*); and in the driest parts *Sambucus Canadensis.* Of herbaceous species growing in the shade of these shrubs, various species of *Polygonum, Impatiens fulva, Cardamine rhomboidea* are among the most conspicuous.

A form of *Betula* is found in these saliceta, which combines some of the characteristics of *B. glandulosa Michx.* and *B. pumila L.* Like the former its branchlets, even the youngest, and leaves are entirely glabrous; the fruit catkins are oval, or rather club-shaped; it does not grow higher than about five feet, and its leaves are but slightly paler on the lower side. On the other hand, there are no distinct glandular warts on the twigs, and the veins are conspicuously reticular on both sides of the leaves, as in *B. pumila.* A form in which just the opposite characters are similarly mingled, that is tall shrubs with pubescent shoots like *pumila,* and conspicuous glandular warts like *glandulosa,* occurs in the Menomonee valley near Milwaukee.

The salicetum is rapidly encroaching on the grass area, as seen by the numerous clumps of young willows noticeable far towards the center of the marsh. On the outside, the shrubs are encircled by an equally irregular and interrupted belt of tamarack forest, varying in width from a few rods to a quarter of a mile. Outside of this the ground rises rapidly to the usual rolling uplands of the region. These are clothed with oak forest, which in many places is on the point of transition to oak-and-maple woods; with the basswood conspicuously numerous. (1)

In a few places the outer belt of tamarack is absent, and the salicetum approaches nearly to the foot of the slope. Here there is between the hardwood forest and the willow brush a narrow belt of mesophytic grassland, on which both forest and brush are encroaching. The outposts of the forest are especially *Populus tremuloides,* while in these drier portions of the salicetum *Salix nigra* and *S. amygdaloides* are more conspicuous than the species mentioned above. There is another characteristic difference in the aspect of the salicetum, according to the degree of wetness. In the lower places the willows show greater lateral than height growth, so that where a clump stands alone in the surrounding grass marsh, it assumes a circular form, like a bowl turned over, with the diameter of its ground area greater than the greatest height, which is in the center. On comparatively dry ground, the height growth is more vigorous than the lateral spread; the individual shoots are fewer in number, and they show much greater diameter. *S. nigra* and *amygdaloides,* in such places, often assume tree forms. (2)

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1. Near by, a little south of Calhoun station, there is a twenty-acre timber lot which is as good a specimen of young maple wood as there is in the region. There are comparatively few old trees left, and these are about one-third oak and basswood, the rest sugar maple. The very dense underwood of large saplings is composed entirely of maple, except for an admixture of hop hornbeam. Oak saplings are entirely absent. The forest floor is formed by dry leaves, with very scanty herbage. This wood, however, is surrounded by a belt of oaks, greatly thinned, which forms a strange contrast. Here the grass occupies the ground to the exclusion of almost all other herbs. Clumps of hawthorn give the area almost the character of heath. There are no young trees, and the old oaks show signs of lessened vitality.

In the midst of this belt, by the way, stands a magnificent, broad-crowned-specimen of *Acer nigra*, which is not a common species in this region.

2. Compare Bruncken. Distribution of Some Trees and Shrubs in the Vicinity of Milwaukee. Bull. Wis. Nat. Hist. Soc., Vol. I, page 38.

Coming now to the tamarack belt, a brief study convinces one that this association is doomed to disappear, even without the interference of man. All its neighbors are making vigorous inroads upon its area. The shrubs from the salicetum are infringing on it, and have penetrated to its very heart. In some places, black ash, elm and other swamp-loving hardwood trees are encroaching. Even the sedges from the marsh are creeping in through every opening, especially along roads made through the swamp. On the other hand, reproduction of the tamarack is entirely wanting. There are no seedlings. The smallest trees are about three inches in diameter, and how old they may be can be guessed from the data given below.

This tamarack swamp, like all I have ever seen in Southeastern Wisconsin, is very different from those in the Northern districts. Instead of having a peaty soil, and a floor composed of sphagnum, the ground flora is not very different from that of the ordinary black ash or willow swamp. Sphagnum mosses are not entirely absent, but comparatively unimportant and confined to the wettest portions. The numerous *Ericaceae* and allied types, so conspicuous in the North, are absent. Only in the driest places, *Pyrola rotundifolia var. incarnata* is found, often in the company of *Majanthemum bifolium, Trientalis Americana,* and several mosses, especially of the genus *Polytrichum.*

During the past winter, some cutting had taken place in the swamp on the north side of the basin. The wood had been cut into billets and stacked, thus giving an opportunity to make some observations on the rate of growth of the tamarack. Twenty-one of the billets were measured and the annual rings counted with the following result:

1. Diameter, 6 inches; number of rings, 37.
2. Diameter, 6 inches; number of rings, 43.
3. Diameter, 5 inches; number of rings, 43.
4. Diameter, 6 inches; number of rings, 44.
5. Diameter, 5 inches; number of rings, 50.
6. Diameter, 7 inches; number of rings, 71.
7. Diameter, 7 inches; number of rings, 73.
8. Diameter, 5 inches; number of rings, 39.
9. Diameter, 4 inches; number of rings, 36.
10. Diameter, 6 inches; number of rings, 41.
11. Diameter, 4 inches; number of rings, 31.
12. Diameter, 6 inches; number of rings, 23.
13. Diameter, 10 inches; number of rings, 74.
14. Diameter; 3 inches; number of rings, 25.
15. Diameter, 6 inches; number of rings, 27.
16. Diameter, 5 inches; number of rings, 46.

17. Diameter, 4 inches; number of rings, 46.
18. Diameter, 11 inches; number of rings, 66.
19. Diameter, 10 inches; number of rings, 72.
20. Diameter, 5 inches; number of rings, 54.
21. Diameter, 4 inches; number of rings, 53.

The billets had no indication of their position in the living tree, so that no inference can be drawn from the number of rings to the age of the tree, except that even a three-inch stem is more than 25 years old. But the table shows clearly the extreme irregularity of the diameter increase as between different trees, and also the very slow growth. All the billets measured, as well as many others merely inspected, showed by far the widest rings toward the center, while the outward rings were invariably exceedingly narrow, showing that during the last twenty years, at least, diameter growth had almost ceased. In cases 1, 5 and 8 there were two rings, about half way between pith and bark, which were nearly twice as wide as those at either side, each being about one and a half millimeter in width. The height of tamarack trees in this swamp is as irregular as their diameter; the tallest may measure fifty feet. It is apparent from the old stumps left, that much larger trees formerly grew in this swamp; for some of these stumps measure fifteen inches, while at present trees of ten or eleven inches are rare, and most of them are much smaller. There is good reason to believe that the above conditions are typical of nearly all the tamarack swamps in the southern part of the state.

From above facts it appears that the small farmers who own these lands are very wise in cutting down tamarack tracts, as they are doing almost everywhere in this region. These lands are not peaty, but have a rich, although sour humus. If drained, they furnish arable land of excellent quality, and even without drainage the crop of marsh hay, which can be reaped from them annually, after the forest is cut, will be more valuable than anything the tamarack could produce under the prevailing circumstances. To the lover of wild flowers, to be sure, the rapid disappearance of the swamps is a source of regret, for among their tangled roots grow not a few species of orchids and other beautiful blossoms.

8. Some Plants from Sheboygan.

Mr. Charles Goessl, of Sheboygan, contributes the following list of plants collected by him in the neighborhood of that city during the year 1901:

Clematis Virginiana.
Anemone cylindrica. Along Black River.
Anemone Pennsylvanica.

Anemone nemorosa.
Hepatica acutiloba.
Hepatica triloba. Pine woods west of city. Not common.
Anemonella thalictroides.
Thalictrum dioicum.
Thalictrum polygamum.
Dentaria diphylla.
Cardamine rhomboidea.
Cardamine hirsuta.
Arabis lyrata.
Barbarea vulgaris.
Erysimium cheiranthoides.
Cakile Americana.
Thlaspi arvense.
Menispermum Canadense.
Berberis vulgaris.
Sanguinaria Canadensis.
Dicentra cucullaria.
Dicentra canadensis. Sparse.
Corydalis aurea. Sandy pine woods.
Ranunculus multifidus.
Ranunculus abortivus.
Ranunculus sceleratus.
Ranunculus fascicularis.
Ranunculus Pennsylvanicus.
Ranunculus acris.
Caltha palustris.
Coptis trifolia.
Aquilegia Canadensis.
Cimicifuga racemosa.
Actaea rubra.
Actaea alba.
Viola blanda.
Viola pubescens.
Viola palmata.
Lychnis Githago (Adv.).
Stellaria media.
Portulaca oleracea.
Claytonia virginiana.
Hypericum Ascyron.
Elodes campanulata. Town Rhine.
Geranium maculatum.
Oxalis stricta.
Impatiens fulva.
Celastrus scandens.

Rhamnus cathartica.
Aralia racemosa.
Aralia hispida. Scarce along Black River.
Aralia nudicaulis.
Aralia trifolia.
Saxifraga Pennsylvanica.
Mitella diphylla.
Heuchera Americana.
Penthorum sedoides.
Hamamelis Virginiana.
Epilobium angustifolium.
Oenothera biennis.
Circaea Lutetiana.
Circaea alpina.
Echinocystis lobata.
Polygala paucifolia.
Polygala Senega.
Polygala polygama.
Melilotus officinalis.
Melilotus alba.
Vicia cracca.
Lathyrus ochroleucus.
Apios tuberosa.
Amphicarpaea monoeca.
Prunus pumila.
Prunus Pennsylvanica.
Prunus Virginiana.
Prunus serotina.
Spiraea salicifolia.
Physocarpus opulifolia.
Geum album.
Geum Virginianum.
Potentilla Norvegica.
Potentilla palustris.
Potentilla Anserina.
Potentilla Canadensis.
Agrimonia Eupatoria.
Rosa Carolina.
Rosa humilis.
Amelanchier Canadensis.

Preliminary Notice of the Forests Beds of the Lower Fox.

PUBLIUS V. LAWSON.

The forest beds of the Lower Fox River have been little exploited. They are found in parts of four counties, underlying an area of 500 square miles between the modified glacial till and Champlain clays.

The pre-glacial valley occupied about the same limits as the present one, extending from the Niagara limestone bluffs on the eastern border, to the Trenton outcrop on the western, and being about fifteen miles wide. But the pre-glacial river bed lay to the east of its present location and over against the foot of the Niagara limestone range. The glacial till filled the valley, as well as the present site of Lake Winnebago, to a depth of about 75 feet.

After the glaciers had receded, the waters of the river filled the whole valley. For many years these waters cleared away the clay from its bed and scouring the limestone rocks deposited its cements here and there in a hardpan, almost impossible to disturb with a pick. This has been stated to be the Beach Formation "A" of the Wisconsin Geological Survey, but it seems to have been a river bed product, rather than a lake beach formation. Above this river bed grew this ancient forest, which now lies buried under from ten to one hundred feet of the lacustrine modified red clay of the Champlain Sea.

Above the polished gravel and hard pan of the river bed grew the forest, forming a bed which is even now, after ages of pressure under millions of tons of later deposits, one and two and in places even three feet in depth. This bed is composed of moss, leaves, grasses, seeds, limbs and branches of trees and saplings and the trunks of trees of all sizes up to 24 inches in diameter. The moss and leaves are pressed into a compact mass, of a dark brown color, bearing patches of light-green or white mould. At John Roy's farm in the Town of Harrison, Calumet County, there are said to have been taken out pine cones and pine logs. Along the border of Lake Little Butte des Morts we have taken out what seemed to be fragments of cedar, black ash and black oak trees, and stumps of trees of black ash and tamarack. At Forest Junction in Calumet County were taken at 26 feet in depth cuts of linden trees. The growth of this lost forest is characteristic in some places of lowland and in others of highland localities.

That the remains of forest growth are not flood wood is evidenced by the stumps still standing with their roots in the soil where they grew. All these stumps bear evidence in their ragged heads of the trees having been violently wrenched off. The most notable stump field is that at Lewis Hankey's brick yard in the Town of Neenah on the west shore of Lake Little Butte des Morts. Here the removal of twelve feet of red clay in brick making has uncovered several acres of stumps still standing and about twelve inches high. The bed of vegetable mould and leaves is here several inches thick and rests on a thin layer of blue clay over the river bottom formation. In 1897 we published an article in the Oshkosh Northwestern on this forest bed in which we described a stump eighteen inches in diameter, fourteen inches high, discovered on Augustine's farm, one mile east of Menasha, under 26 feet of red clay, which had been artificially severed. The forest is found in well diggings along the borders of the slough which enters the south end of Lake Little Butte des Morts. It extends six miles along the western border of the lake at the about the level of the water and is found at Allison's place and Alward's Foundry at a depth of twenty-six feet in well diggings. At one place a log twenty-four inches in diameter was penetrated. But for three miles along the eastern shore of Little Lake Butte des Morts there are exceptional opportunities to study the bed, as at low water it is exposed just above the level of the water, and the ragged stumps rising up through the red clay beach are used by the fishermen to fasten their boats, and wagon loads of its ancient woods can be obtained in a few hours. Along the lands bordering this shore it is found in digging wells at depths varying from six to nineteen feet. At the Pulley Factory in Menasha at sixteen feet, the bed contains a mass of trees from four to twelve inches in diameter, mostly cedar and pine, with two feet of the brown moss and leaf mould. At Round's farm three miles down the lake it is found at sixteen feet; at Tyckman's half-way house, one mile east, at seventy feet. It was traced in Manasha for a distance of over a thousand feet at a depth of thirteen feet when Sixth Street sewer was laid. Two miles further east it was found at Bayer's farm at thirty feet. Near Hunt's farm it was found at two places at ten feet. Further east of Menasha, in the Town of Harrison, north of Lake Winnebago, it was found at Geo. Schwalbach's place at sixty feet in depth. At Mix's place, three miles east, large trees were drilled at eighty feet. At Loux's place it was penetrated at forty feet; at John Roy's place at nineteen feet; at the base of the Niagara bluffs at Clifton on Nugent's place at fifteen feet; near Sherwood in Calumet County at eight feet on top of blue clay; at Forest Junction at twenty-six feet on blue clay of the Cincinnati shale. Several of the above levels of the forest bed are from forty to fifty feet below the level of Lake Winnebago. Coming now back west to Appleton in Outagamie County it is found on the south side of the river at one place at a depth of twelve feet on blue clay. At Appleton in the Fourth ward on the south side of the river at a well drilled for Father Kaster's Church or Hospital, the reading of the soil, made by Geo. Schwalbach, driller, was as follows: Red clay, 60 feet; hard logs, 2 feet; blue clay, 1 foot; soft logs, 2 feet; gravel.

We now come to the region north of Appleton which we might name the "Gas fields of Outagamie County." I am informed by Mr. Picklin, well driller, that no forest bed is discovered in the town of Cicero; but between this town and Appleton it is found in the towns of Black Creek, Center and Grand Chute. I have one reading of a well made in Center by Mr. Picklin: Red clay, 15 feet; sand, 80 feet; blue clay, 25 feet; wood, leaves and stumps, two feet; gravel. At Linas' farm, north of Appleton, he found logs twelve to fourteen inches diameter at forty-five feet in depth. Mr. Joe Pringle, well driller of Binghamton, sends me reading of the recent gas well, so widely heralded in the public press: Clay, 7 feet; sand, 15 feet; red clay, 40 feet; gravel, 12 feet; red clay, 6 feet; trees, stumps, leaves, 2 feet; gravel, 10 feet; rock.

This well was located nine miles east of Wolf river, in the town of Center, about seven miles north of Appleton. A number of wells in the surrounding country have been noticed to give off gas. A similar gas well was discovered several years ago in Grand Chute and created considerable flurry in speculative circles. This was marsh gas produced by decaying vegetation of the forest bed. The moss, leaves and wood from the forest bed are only partially rotted. The wood after being dried becomes hard and brittle. Some fragments supposed to be oak have turned partly into lignite. This snaps into fragments on slight pressure and is black and glassy on fracture, bearing the appearance of coal.

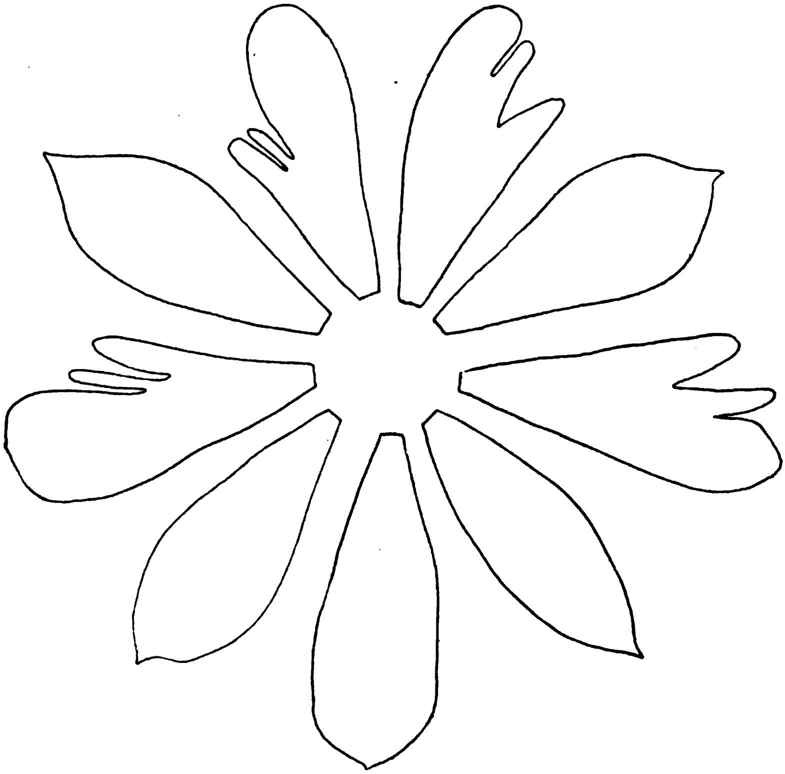
At Green Bay some trace of this submerged forest is reported to us by drillers at twenty-four and fifty feet below the surface; and Prof. Chas. Whittlesey in Foster's and Whitney's Report on the Lake Superior Land District, published in 1851, part 2, page 394, reports in a boring at Green Bay, at a depth of forty-three feet, a bed two feet thick, of rotten wood and leaves lying between strata of red and blue clay. The wood being submitted to M. Lesquereux for examination was pronounced by him to be cedar.

The vegetable remains of this ancient forest have never been subjected to expert investigation and the names above given may not be the correct ones. The bed has never been explored by geologists, and much yet remains to be done in the way of determining its extent in the state and the conditions under which it was formed. The forest seems to have extended considerably beyond the region above described, as particles of buried wood have been brought up by well-diggers from great depths, and escaping gas detected at various localities near the eastern boundary of the state as far south as the southern portion of Milwaukee County.

Note on a Bilateral Tulip.

ROSWELL HILL JOHNSON.

The tulip here referred to was observed in the greenhouses of the Howard Botanical Garden in the early spring of '99. Since I find that only one other case of this kind is on record I venture to send you this drawing of the perianth-segments, the only record I made at the time. Although the four lobed segments are not identical, the nature and position of the lobes show apparently a fundamental bilaterality.



The previous case is that described by A. Pippow in "Ueber das Auftreten scheinbarer Zygomorphie bei regelmaessigen Bluethen," in "Sitzungsberichte d. Bot. Ver. d. Prov. Brandenburg 1877, p. 74." I have been unable to see the original article. It is referred to in Penzig's "Pflanzen-Teratologie" as follows: "Durch symmetrisch vertheilte Einschnitte in den Perianthblaettern werden die Bluethen gelegentlich pseudo-zygomorph."—University of Wisconsin, March 1, 1902.

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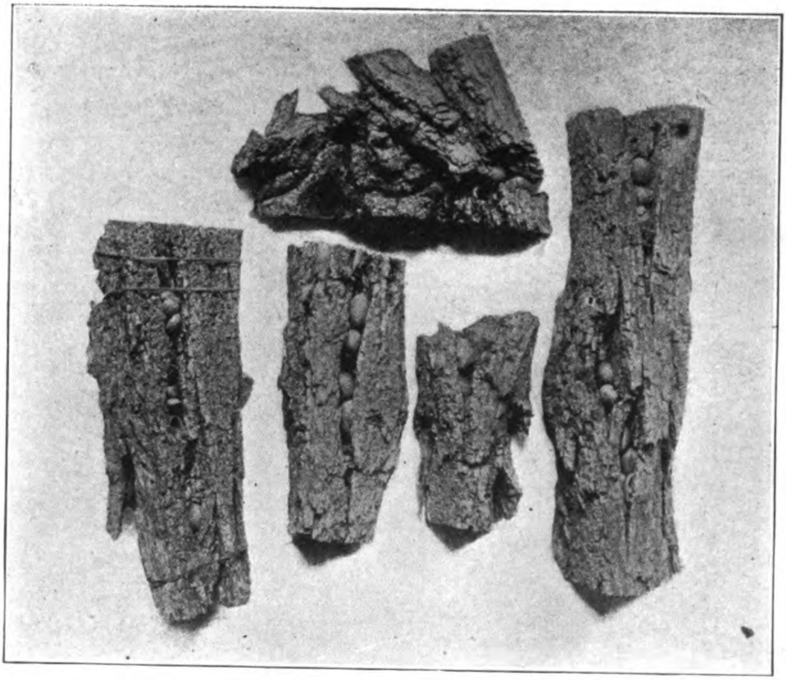

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Exchanges should be mailed to the Wisconsin Natural History Society, in care of the Public Museum, Milwaukee, Wis. Communications should be addressed to the General Secretary.

The Migration of Birds

With Special Reference to Nocturnal Flight.

H. A. WINKENWERDER.

PREFATORY NOTE.

During the fall of 1897 Dr. O. G. Libby called my attention to the excellent facilities the telescope offers for the study of bird migration, and upon his advice I took up the following work in the summer of 1899. It was intended that the paper should be complete in 1901, but owing to the pressure of other work and the amount of material collected this became impossible.

Since so much in any one phase of the subject of migration depends upon a knowledge of the phenomena of the other phases, it becomes necessary to treat certain parts of the entire subject in order that the reader may obtain a clear understanding. The following paper is consequently divided into four chapters, A Historical Review, The Causes of Migration, Migratory Routes, and The Manner of Migration.

The reasons for presenting a historical review are (1) because I had the material on hand; (2) because the only paper of this nature in the English language, that of Dr. J. A. Palmen in the Smithsonian Report of 1892, deals only with the development of certain phases of the subject, and tells very little of the work done in America; (3) because it is an important adjunct to the rest of the paper. For much in this chapter I am indebted to Palmen's Ueber die Zugstrassen der Vögel.

I am aware that for the past decade, or a little more, there has been a tendency to attribute the causes of migration to the failure of food. It is still, however, a very general belief, especially with regard to the spring migration, that food is only a minor cause. Furthermore, I am not aware that the causes of migration have ever received special treatment, hence have included a chapter on this subject.

The remaining two chapters are the result of a method of investigation that has heretofore received very little application. The telescope offers a means for watching nocturnal migrants while they are in actual migratory motion. Though we gain a view of only an infinitesimal portion of the vast migratory wave in so small a field of vision, enough is revealed to make it well worth the undertaking.

Since a great deal of the work on migration has been done in Europe, I have been unable to secure much of the valuable literature that I should have had. For such as I had access to I am indebted to Mr. H. Nehrling and Mr. Paul Dernehl, both formerly of the Milwaukee Public Museum.

I wish especially to express my thanks to Dr. O. G. Libby for the abundant help he has given me and the interest he has shown throughout the entire work. Also to Prof. Geo. C. Comstock, of the Washburn Observatory, for the use of telescopes. One of three instruments—the finder on the large telescope, the students' telescope, or a large portable telescope—was at my continual disposal. Other acknowledgments will be found in their respective places.

CHAPTER I.

HISTORICAL REVIEW.

No one can doubt that the great semi-annual movement of the migratory birds must have been noticed and commented upon even from the earliest times. The Prophet Jeremiah refers to the appointed times of the stork. Anacreon wrote in his Thirtieth Ode,

"Lovely swallow once a year,
Pleased, you pay your visit here;
When our clime the sunbeams gild
Here your airy nest you build;
And when bright days cease to smile
Fly to Memphis or the Nile."

So far back as the times of Hesiod, we are informed that husbandry was in great part regulated by the coming of the birds. It has been stated that Persians and Arabs compiled portions of their calendars according to the regular movements of the birds; that North American Indians foretold an early spring or a cold winter by the appearance or disappearance of birds; and that superstitious people of all times saw forebodings of good or ill in certain of the migratory movements.

But it can be said that prior to the eighteenth century bird migration was scarcely looked upon as a biological phenomenon. Dixon says that Belon watched birds migrating three hundred years ago, that a century and a half ago Gilbert White (1), Dennis Barrington and Thomas Pennant watched migratory movements in England, and on the continent contemporaries with Linnæus studied these periodical flights (2). Palmen says: "Linné admonished natural philosophers to observe the migration of birds. Quetellet then in the year 1841 asked that changes in living nature also be noted in a regular and comprehensive manner, and his countryman de Selys Long-Champs proposed to collect data especially on the migration of birds" (3).

But it was not until the middle of the nineteenth century that this study began to assume a systematic form. The collection of data on migration, however, was at first of secondary importance, the material being used for climatological purposes. Although a few individual observers were occupied in watching these movements for over two hundred years before this, nothing could come of such few and incomplete observations. Each observer formed his own conclusions, resulting in such absurd statements as that migratory birds went to the moon, that certain species were transformed into others, and some of the world's most eminent naturalists held the idea that birds became torpid and passed into a state of hibernation. This last theory held a prominent place for a long time, and relative to certain birds even to very recent times (4).

From 1840 to 1876 much work was done on zoography, but much of the material collected was used by climatologists with a view to finding an expression of the corresponding regions. Although Dernham as early as the year 1708 published a work on the periodicity of migration and its relation to climate, similar work was not undertaken until in the time of Quetellet in 1841, and then for climatological purposes. While it cannot be said that

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1. Gilbert White, Natural History of Selbourne.
2. Dixon, The Migration of Birds. London, 1892, p. 123.
3. Palmen, Report on the Migration of Birds. Smithsonian Report. 1892. P. 375.
4. Cowes, Birds of Colo. Valley, pp. 372 et seq.

this climatological work was a lurking remnant of the superstition of the people when they first noticed the regular movements of certain birds, we may look to this as the probable origin of these lines of investigation. A writer in All the Year Round says: "When man began to meditate upon the movements of certain birds, how they all disappeared at a certain time as if by common consent, and then reappeared after a certain interval, they not unnaturally fell into the error of mistaking cause for effect and regarded the birds as regulating the seasons instead of the seasons the birds" (5).

Zoologists, however, saw another use for these data and it was mainly through the influence of two naturalists in Russia that this climatological material was turned to zoological ends. Kessler in 1852 attempted to determine something of the courses taken in migration, but arrived only at the general directions followed (6). Middendorf two years later called attention to the importance of working over the material collected by the climatologists, and during the same year made the first attempt to reduce the flight of birds to law (7).

Most of the work on migration was now directed toward an attempt to determine the direction of flight. Though many of the first fruits of this work were of little value from the standpoint of fact they immediately led to those important lines of investigation which were to form the foundation of research in migration.

Although systematic work was now in progress, the direction which the course of investigation must take was not clearly understood until 1871, when Sunderal made known the routes of the crane in Europe. It then became evident that there were definite routes followed in migration and that these routes would have to be the first phenomenon to be dealt with. That definite routes were followed had already been hinted at by Linne, Schlegel, L. Brehm, J. F. Nauman and Baird, but it remained for Palmen to give definite form to this line of investigation. Brehm as early as 1828 refers to "Heerstrassen," and in 1846 Nauman added to this the idea of definite resting places—"Erholungsorten"—stations at which birds stopped in their long journeys to rest and feed (8). Middendorf in 1859, from careful investigation, showed almost conclusively that the migratory movement takes

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5. All the Year Round, vol. 13, p. 376.
6. Palmen, Ueber die Zugstrassen der Voegel, pp. 11 and 12.
7. Ibid.
8. Palmen, Ueber die Zugstrassen der Voegel. Leipzig, 1876, p. 6.

place in a general north and south direction in eastern Europe (9). Although he fell into serious error regarding migratory routes, his methods of investigation were good and acted as a stimulus to other ornithologists throughout Europe and western Asia. Another important advance was made in 1866 by Dr. Baird when he traced the lines of dispersion of a number of American birds and intimated very strongly that birds followed certain geographical features in their migrations (10). Baird's work is of great importance. He certainly anticipated the work of Palmen. It is indeed peculiar that a work of such importance did not immediately stimulate others to direct their efforts along these lines.

Palmen saw the necessity of pursuing a definite course of investigation and followed these initial movements by studying in detail the routes of a small number of hyperborean species. In 1876 he published his results under the title, "Ueber die Zugstrassen der Vögel" (11). Beside having thus laid the foundation for the study of most migration phenomena he immediately reaped some of the results that were to follow. He not only showed that definite routes were followed, but established definite fly-lines for entire Europe. Through these investigations we may also say he fixed our present laws regarding migratory routes, namely, that these routes are geographically defined courses.

These principles of Palmen were at first rejected from nearly all sides. His statements were not only looked upon as conjectural but even rash. However, as investigation proceeded, the importance of his work gradually became more and more evident and it was quite soon accepted (12).

With the increasing interest in migration among zoologists the time was ripe for theory. Prior to the work of Palmen the theoretical side of the question was largely speculative. One theory which had some influence in the scientific world was that of the Swedish poet Runeberg who claimed that migration was caused by the season of perpetual darkness in the north. He conceived the idea that as darkness gradually fell over the north pole the birds were attracted southward where there was more light. Another interesting case is that quoted by Prof. Newton from the London Times for September 18, 1874, which professes to give the latest accepted theory:

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9. Die Isopiptesen Russlands. Mem. Imp. Acad. of Sciences of St. Petersburg, 1859.
10. Baird. Amer. Jour. of Science, 1866.
11. Palmen, Ueber die Zugstrassen der Voegel. Leipzig, 1876.
12. Nature, vol. 15, p. 465; vol. 11, p. 433. Journal f. Ornith., 1876, p. 390.

"I believe it was only some twenty or thirty years ago that anything like a practical solution of the difficulty was arrived at. The birds congregating about the south coast (i. e. of England) are seized with a sudden impulse, or mania, to fly upwards. This is caused by some atmospheric change, coinciding with a warm south wind moving in a high stratum, into which the birds soar with an involuntary motion of the wings. This motion (involuntary like that of the heart) is continued for many hours, and the birds fly blindly along until the paroxysm passes off, when they at once begin to descend, making many a fatal drop into the sea" (13).

The results of Palmen's work, however, threw light upon the causal phenomena of migration, and we have the appearance at about this time of two excellent theories explaining the origin and causes of migration. Although various influences connected with this phase of the work had been correctly hinted at by Darwin, Baird (14), Newton (15), Hutton, and others, it was not until 1874 when Dr. Alfred R. Wallace advanced an explanation that we have had a really excellent theory in complete and concise form. This was about the time when Palmen's work appeared; whether Wallace was influenced by the work of the latter or not is difficult to say. If not he certainly anticipated something of the nature of his results. Another theory appeared soon after from the pen of Dr. August Weismann, who tells us that he fully accepts the results derived by Palmen.

Wallace writes, "It appears to be probable, that here, as in so many other cases, survival of the fittest will be found to have had a powerful influence. Let us suppose that in any species of migratory birds breeding can, as a rule, be only safely accomplished in a given area; and further, that during a great part of the rest of the year sufficient food cannot be obtained in that area. It will follow that those birds which do not leave their breeding area at the proper season will suffer and ultimately become extinct; which will also be the fate of those which do not leave the feeding area at the proper time. Now, if we suppose that the two areas were (for some remote ancestor of the existing species) coincident, but by geographical and climatic changes gradually diverged from each other, we can easily understand how the habit of incipient and partial migrations at the proper seasons would at last become hereditary and so fixed as to be what is called an

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13. Nature, vol. 10, p. 415.
14. Am. Jour. Science, 1866; p. 178 et seq.
15. Nature, vol. 10, p. 415.

instinct. It will probably be found, that every gradation still exists in various parts of the world, from a complete coincidence to a complete separation of the breeding and subsistence areas, and when the natural history of a sufficient number of species is thoroughly worked out, we may find every link between species which never leave a restricted area in which they breed, and live there the whole year round, and those other cases in which the two areas are absolutely separated" (16).

This theory exerted much influence upon the students of the time and is still often quoted as an explanation.

Weismann presented his theory in a quite lengthy discussion in 1878 (17). His first step is to show why birds migrate at all, and he arrives at the conclusion that it is mainly due to an absence of food in the northern and southern portions of the geographical distribution of birds at opposite seasons of the year. He conceives the idea that the original home of the birds is in the tropics, and that from here they dispersed into the temperate and friged zones, met with unfavorable conditions in winter and were forced to seek new areas. A struggle for existence ensued, resulting in the survival of those that returned to the south. Through natural selection the phenomenon of migration then became an instinct.

"Let us suppose, for example," he says, "that the waxwing had not become an inhabitant of Russia, but was living summer and winter alike in Germany, slowly multiplying and therefore gradually extending its range further north.

"Now we will imagine a flock of these birds to have colonized further north. In the very first winter they would find their food becoming scarce, and would be compelled to wander about in search for it; all, that is to say, which had taken a wrong direction. Only those which, whether by accident or by remembering the way they had come, took a southerly course, would have any prospect of outliving the winter.

"In each succeeding winter, therefore, a selection would take place among the northern colonists, and only those would remain alive which had migrated southward. As these alone would remain to perpetuate in the next year, this habit of a southerly flight would be transmitted to their descendants, and so a race would arise predisposed by habit not to wander hither and thither

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16. Nature, vol. 10, p. 459.
17. Contemp. Review, vol. 34, p. 531.

in winter, like the green woodpecker (18), but to take a definite direction, namely, to the south."

He then shows that in the eider duck of Europe we have every stage from a migratory bird to one that is stationary, and we find it, therefore, in the Arctic zone a genuine migratory bird, in the Baltic only a wanderer, and in the North Sea a resident—"a conclusive proof that migration and wandering are not essential characteristics of the species, but a habit which is adopted when the necessities of life require it, and a proof, moreover, that the regular migration has grown out of the irregular wandering in search of food."

Much valuable work as well as much speculation has also been done on the question how birds find their way between their summer and winter homes. The first careful investigations on this subject were undertaken by Dr. A. von Middendorf, in 1855, and resulted in his well known work Die Isopiptesen Russlands (19). He found that the direction of migration in Russia is in general toward the north pole, and conceived the idea that birds must be endowed with a sixth sense, a magnetic sense of direction. Palmen, a few years later, revealed Middendorf's error when he showed that the direction followed depends almost entirely upon the topography of the countries through which the migrations extend (20). The general belief then was that young birds are first led over a course by one or several older, experienced birds, and that through sight and memory these courses are followed year after year. The investigations of the older American ornithologists seem to indicate that this is actually the case (21). Herr Gatke, however, seems to find from his extended observations on Heligoland that it is not so there. He says innumerable flocks pass his station of observation year after year composed entirely of young birds (22). This subject has been the cause of much controversy among ornithologists and is still an unsettled question. Recent observations along this line show us nothing definitely one way or the other (23).

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18. Or like our waxwing, the tree sparrow, many of our hawks, and others.

19. Die Isopiptesen Russlands. Mem. of the Imp. Acad. of Sc. of St. Petersburg, 1859.

20. Palmen, Ueber die Zugstrassen der Voegel.

21. Brewster, Bull. Nutt. Ornith. Club. No. 1, p. 15.

22. Heligoland, An Ornith. Essay, 1895.

23. Barrington, The Migration of Birds observed at Irish light-houses, 1888-'97. Dublin, 1901; also Bailey, Proc. Del. Valley Ornith. Club, No. 3, p. 13.

Before 1850 comparatively little was accomplished. At about this time the subject of migration seems to have become of interest to zoologists in general. In America the initiative was taken by Dr. Baird in 1866 (24). In Europe, although the work was well under way, interest increased immensely. The investigations of Herr Gatke, Middendorf, Severtsoff, Homeyer, and Palmen, now appeared and stimulated others to action. May the 22nd, 1875, the General German Ornithological Society met at Brunswick and undertook a systematic collecting of data. This marks the beginning of a national form of investigation. The ornithologists of a nation combined their efforts and elected officers who could supervise the work to the best advantage. Similar work was begun in England in 1879, and in Austria-Hungary in 1880, while the remaining countries of northern Europe followed their example during the next few years (25).

In our own country similar investigations were begun by Prof. Cooke in 1881. Prof. Cooke's field of observation included that part of North America ordinarily known as the Mississippi Valley. All the ornithologists of the district were asked to co-operate in the collection of data. Although observations were contributed from only thirteen persons in 1881, another attempt was made in 1883 resulting in reports from twenty-six persons. The results of these investigations were published in the leading ornithological periodicals of the time.

In 1883, the year which marks the advent of the American Ornithologists' Union, the work begun by Prof. Cooke was widened into a scheme of national extent. A committee, with Dr. C. Hart Merriam as chairman, was appointed to co-operate with Prof. Cooke. This gave a great stimulus to ornithologists all over the country, and the list of observers, now nearly 700 strong, was scattered all over the United States, British America and Alaska. Beside this the committee secured the co-operation of the Light-house board. The field of observation was divided into fourteen districts each with a competent superintendent at its head. With such an elaborate and extended scheme it is not to be wondered at that the results have far exceeded all expectations (26).

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24. Baird, The Distribution and Migration of N. A. Birds. Amer. Jour. of Science, 1866; pp. 78 et seq.

25. Palmen, Rep. on the Migration of Birds. Smith. Rep. 1892, p. 3. For accounts of the work done by these societies see Jour. Ornith., 1875-1883.

26. Merriam, Auk, vol. 2.

The work of Cooke, superintendent of the Mississippi Valley District, has broadened into several new fields of inquiry. In addition to the report proper he has included original discussions upon "The Relation of Migration to Barometric Pressure and Temperature" and "The Rate of Speed at which Birds Migrate." Although these new phases of the work were not undertaken until the period of investigation was nearly completed, and hence were merely experimental, the methods employed have opened several new fields to the students of migration (27). Mr. Witmer Stone followed Prof. Cooke's method of work on a less extended basis and has presented us with a means of representing "bird waves" (28), graphically (29).

Another entirely new department was brought into the method of observation in 1880, by Mr. W. E. D. Scott, who applied the telescope to the study of migration problems. This method, although of extreme importance, seems to have found little actual application. Beside the work of Messrs. Allen and Scott in 1881, and that of Mr. Frank Chapman in 1887, practically nothing was done until it was taken up by Dr. O. G. Libby of the University of Wisconsin in 1897. Since 1898 the telescope has been used for this purpose by Dr. Libby and the writer, at Madison, Wisconsin, each year up to the present time. During the spring of 1900 a wider application of this method was obtained by asking a number of interested persons from our western universities to co-operate. These data together with all those that were taken at Madison will appear in the following report.

The facilities for studying migration at light-houses have long been known. It was upon the suggestion of Prof. Newton in 1880 that a systematic collecting of data from this source was first undertaken. Individual work at light-houses by experienced ornithologists has given us many valuable facts. Indeed the investigations of Herr Gatke on the Island of Heligoland (30), of Brewster at Point Lepreaux (31), and Chapman on Bartholdi Statue (32), should stimulate others to direct their efforts along these lines.

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27. Cooke, Rep. on Bird Migration in the Miss. Valley. Bull. No. 2, U. S. Dept. of Agr. 1888.

28. A "*bird wave*" may be considered to consist of a very large number of individuals, of one or more species, which suddenly invade a certain area."—(Cooke.)

29. Auk, vol. 8, p. 194.

30. Heligoland, An Ornithological Essay. 1895.

31. Bull. Nutt. Ornith. Club, No. 1, 1886.

32. P. S. M., vol. 45, p. 506.

During the past fifteen or twenty years much valuable work has been done on geographical distribution. Every student of migration must recognize the importance of a knowledge of the geographical distribution and dispersion of birds. The extended works of Baird, Allen, Merriam, Chapman, Hasbrouck and others on distribution, and the local bird lists that have appeared in recent years are invaluable as aids in the study of migration problems. During the past twenty years a great advance has been made in work of this nature. Beside the many town and county lists that have appeared, there are state lists for many of the states of eastern North America. From the Bahamas, the West Indies and the northern portions of South America much information has been obtained on the distribution of birds that is invaluable for the study of migration problems.

Thus the problems of migration, after passing the period of superstitious beliefs, were next pursued for their immediate importance to climatological ends. At about the middle of the nineteenth century naturalists turned them to the interests of zoology. The first point, then, was to establish the most advantageous course of study, which resulted in the national form of investigation. During the past two decades, besides the many important results obtained, new fields and methods of investigation have been opened to the student, and at the present time individual observers and others united into societies are at work in nearly all parts of the world.

CHAPTER II.

THE CAUSES OF MIGRATION.

We know that birds leave us in the fall and that they return again in the spring; we know something of their habits during migration, and we know of the changes in living nature concomitant with many of these flights. There are, however, so many influences that might affect migratory movements that this subject is not easily handled. Whatever these influences are, we know that they affect different birds in different ways; that they are operative over vast areas at the same time, and set countless numbers of birds in motion simultaneously. In the fall migrations begin with the sunny days of July and continue even until the earth is covered with snow and ice. In the spring some of our migrants may be seen as early as the middle of February, while others are still on their northward way when the first have already performed their parental duties. So closely do spring and fall movements approach each other that only a narrow interval of time, if any, separates them. Thus we have a multitude of diverse conditions: changes in temperature, humidity and living nature, any or all of which may have an influence upon migratory birds.

In the yearly cycle of migration we have the northward movement in the spring and the southward movement in fall. With a very few exceptions, writers upon this subject seem to have been agreed that there are different influences operating in each instance. In the fall it was the approach of winter and the failure of food, in the spring the love of home and nesting ground, and the difficulties of breeding in the south. There can be no doubt that of these various influences each may play some small part as a factor in the causes of migration. Let us analyze the various influences.

From a merely superficial view of the physical conditions existing during the migratory season it would seem that temperature is a most important factor as a cause for the fall migration. Indeed, it was considered so for a long time, but at present it is beginning to be looked upon as only of secondary importance. Almost every student of birds can cite cases where strictly migratory species have wintered far to the north of their northern winter limits, when the food supply was sufficiently abundant to insure their existence.

Prof. Cooke says: "Thus many Red-headed Woodpeckers remain through the winter in northeastern New York, frequenting the heavy timber where there is a great quantity of their favorite food; and it is not unusual for a few Robins to spend the winter in north central Wisconsin, sheltered by the thick pine forests; while ducks and even Wilson's snipe have been known to remain throughout the whole winter in Wyoming, near the hot springs, whose warmth kept the neighboring waters and ground from freezing" (33).

Dr. O. G. Libby has noted a Wilson's Snipe remaining near an open spring in northern Wisconsin the whole winter. Instances of this kind are met with almost yearly. During the winter of 1899-1900 a remarkable case was brought before the writer. In November, 1899, the Red-headed Woodpecker was observed storing acorns in the crevices of the bark of our larger oaks (see frontispiece). Before winter had fairly set in a great many trees about Madison contained hundreds of the acorns. As the winter

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33. Cooke. Rep. on Migration in Miss. Valley. Bull. U. S. Dept. of Agr. Div. Econ. Ornith., No. 2, p. 11.

wore on they gradually disappeared, and upon the approach of spring they were nearly all gone, having been eaten by the birds. Upon further investigation these birds were found distributed in certain localities throughout the state as far north as Polk County, in some instances in groups of over a hundred. In the majority of cases the acorns were found with the birds (34).

These cases show rather strikingly that the influence of temperature upon migratory birds cannot be universal. The frequency, however, with which like phenomena have occurred, and the wide range of species that have been observed under similar conditions, might lead us to believe that temperature, per se, has no influence whatever. In fact, when we consider that many of our warblers, fly catchers, vireos, and others, leave for the south at times when they might still enjoy from one to two months of mild weather before the approach of winter, it would seem that even among the more delicate species temperature has a less determined influence than is generally supposed.

In the examples given above we have in each instance found that the locality in which these species were discovered was connected with some unusual source of food supply. The term unusual should be emphasized because the phenomenon we are discussing is an unusual phenomenon and we may expect an unusual cause. When two phenomena are thus uniformly associated we may be justified in making one the cause of the other. The importance of food as a factor in migration at once becomes evident. According to their food habits birds may be classified as animal-feeders and vegetable-feeders, according as they show a preference for animal or vegetable food. From a migratory point of view they are classified as summer residents and winter residents, the former including those that migrate south at the approach of winter and the latter those that remain in the north throughout the year. Thus, as winter residents we have the ruffled grouse, the crossbills, the pine grosbeak and the linnets as examples of vegetable-feeders; and the creepers, tits, nuthatches, hawks and owls as examples of animal-feeders. Among the summer residents are the thrushes, fly-catchers, cuckoos, snipes, plovers, warblers, vireos, swallows, the meadow lark and the bobolink as animal-feeders; and the red-winged blackbird, pigeons, ducks, geese and a few of the sparrows as vegetable-feeders. It is a noticeable fact that in winter examples of strictly vegetable-

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34. Winkenwerder. Notes on the Winter Habits of the Red-headed Woodpecker. Bull. Wis. Nat. Hist. Soc., vol. 2, N. S., p. 69.

feeders are much more readily found than animal-feeders, which is not at all surprising, since the proper kind of animal food is very scarce during the winter.

We may classify the food of birds according to the following table:

1. Food accessible only in summer.
    - A. Animal food: most insects—adults, larvæ, eggs; myriopods, crustaceans, molluscs, worms, batrachians, reptiles, fishes.
    - B. Vegetable food: all soft fruits, flowers, leaves and all green vegetation.
2. Food accessible summer and winter.
    - A. Animal food: birds, mammals (in limited numbers), a very few spiders and insects.
    - B. Vegetable food: buds, seeds and nuts in abundance, a few berries.

An examination of this table will show that both the animal and vegetable foods accessible in winter will not be accessible except to such birds as are especially adapted to obtain them. Hawks and owls are adapted to feed upon birds and mammals, themselves winter residents; the chickadee, nuthatch and brown creeper—which we might call our winter insect-feeders—are adapted to feed upon such food as they obtain by prying about in the crevices of tree trunks, fences and stone piles, where insects and spiders are lodged in abundance; the crossbills, linnets, grosbeaks, grouse and quail are adapted to feed upon seeds and buds. None of the *strictly* summer residents are physically capable of capturing birds and mammals. Among the insect-feeders that are summer residents we have, roughly speaking, three classes: (1) Such as obtain most of their food upon the wing, as the swallows and flycatchers; (2) such as obtain it largely upon the ground, as the meadow lark, and (3) such as obtain it largely from among the boughs and leaves of trees, as the warblers and vireos. Of these we cannot say that any are adapted to obtain food with the methods employed by the winter insect-feeders. So, too, with the other animal-feeders, such as are represented by the snipe and plover—in winter time their food is covered by snow and ice. The vegetable food accessible in winter, chiefly buds and seeds, is again of such a nature that unless a bird be especially adapted to obtain it he cannot remain here over winter. He needs must be a bird with a strong bill and well developed muscles to operate this in order to obtain a subsistence from the buds and seeds that are at all abundant in winter.

It will be needless to go further into detail regarding this matter. A little reflection shows readily that all birds are dependent upon certain kinds of food, that they are especially fitted by nature to obtain this particular food, and in nearly all cases are physically incapable of obtaining any other, and hence that in order to insure their existence they must migrate when their particular kind of food fails. In winter the food of our summer residents fails. Their animal food is not found where they are wont to capture it and their vegetable food is scarcely to be found at all. The food of the robin lies below the snow, that of snipe and sandpiper is covered by ice, and that of swallow and nighthawk is not now on the wing. The cherry tree is bare to the rose-breasted grosbeak, and for the warbler or vireo there is not even a leaf where he may look for an insect.

It has been maintained for years that the question of food will never explain the vernal migrations, however well it serves that purpose in autumn. Our study of the phenomena pertaining to bird life, until recently, has been very limited in the south. In the north, however, these phenomena have been worked out in detail. It has been shown that the most important factor in the fall migration is the food supply. The assumption that the question of food will not explain the vernal migration has probably been due to our ignorance of the physical conditions of the south. According to Dr. Aug. Weismann, ponds, rivers and creeks become dry, insects disappear and even vegetation fails in many regions in the south in summer. Dr. C. H. Merriam has more recently discussed this question from the same standpoint. Mr. C. R. Ricker says: "During the dry season many forest trees shed their leaves and the grass and small shrubs wither, while the palms and the majority of other trees bear their fruit; * * * *" (35). Hence we are at present quite safe in saying that birds must migrate both in spring and fall because the food supply fails. In fact, the investigations carried on in the south during recent years seem to corroborate these views. The investigations of Mr. Ricker along this line are especially valuable and it is hoped that future investigation in the south will help establish the facts that are still in a state of doubt. Mr. Ricker says further: "The abundance or scarcity of a large number of species I found subject to daily fluctuation, dependent upon the presence of the army ant or some fruit suddenly ripening, there being scarcely two consecutive days when birds could be

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35. Ricker. The Auk, 1890, p. 131.

found plentifully on the same feeding ground." (36). Do not cases of this kind give us rather striking evidence that the food supply of the south is limited?

We have thus two areas in the geographical distribution of birds that are deficient in food at opposite seasons of the year, and we can see readily enough the cause for migration both in the spring and in the fall.

It is still a quite general belief that love of home and nesting ground is among the important factors causing the spring migration. Ornithological literature contains innumerable references to cases where birds have returned year after year to the same locality or even the same tree or the same box. Prof. Newton, in discussing this question, cites a case of this kind. "A pair of Stone Curlews (Oedicnemus crepitans), affecting almost exclusively the most open country," he says, "were in the habit of resorting for many years to the same spot, though its character was entirely changed. It had been an extensive rabbit warren and was become the center of a large and flourishing plantation. It seems to me, therefore," he says further, "that among the causes of migration the desire of returning to old haunts must be included" (37).

But Prof. Newton forgets that any of a vast number of influences, which have no direct bearing on the phenomena of migration whatever, may be operating upon the birds to bring them back to this same spot. In fact, it would seem in the case he has cited that other forces have been in operation. Old haunts would be attractive only on account of their surroundings. If, as he says, these were entirely changed, then, of course, they could no longer be attractive in and of themselves. It is a general belief that the sense of memory is well developed in birds; but, if the object of their memory no longer exists, by what shall they recognize the place?

We have found in the preceding discussion that birds are quite dependent upon their food supply, and that they are willing to undergo the hardships of an unfavorable environment providing their means of existence be assured. Furthermore, we know that birds must leave their most favored haunts if the conditions become unsuited to their needs of feeding and breeding. In another connection it will be shown that birds are quite dependent upon certain definite courses in their migrations, and that even in the absence of home affection they might be led to the imme-

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36. The Auk, 1890, p. 131.
37. Newton. Nature, vol. 10, p. 416.

diate vicinity of their old homes. There can be no doubt that birds are endowed with well-developed mental capacities, and that it is by virtue of these that they return to the same tree or the same box. But even here we must consider the fact that if any individual, or species, develops certain characteristic habits in feeding, breeding, or whatever they be, so long as they are advantageous it will endeavor to find conditions where these habits may be practiced. While we may thus find birds returning to their old homes year after year, and while memory, home affection and habit all contribute as explanations for this periodical return to the same place, we must not forget that these influences may be merely local. The facts pointed out above show that they are local, but there are no facts from which we can infer that they are more than local.

We know that migration takes place in a general north and south direction, that definite physiographic courses are used as guide-lines in migration, and that some birds return year after year to the same home. It has been shown that there are reasons why birds should leave the south in spring, and it will be shown that even in the absence of home affection migratory routes will lead them back to the locality from which they came.

Another favorite argument for the love of home and nesting ground is to be found in the fact that our early spring arrivals are often met with conditions that are most unfavorable. It is argued that birds show a desire to return to the familiar scenes of the previous summer because they push northward in the spring in spite of cold, sleet and snow. This argument, even more than the preceding, is extremely conjectural. It is only in a comparatively small number of species, and of many of those only in a certain number, that we have anything we might call a rapid pushing northward in spite of cold, sleet and snow. Furthermore, we must consider that the birth rate in birds is very limited. The majority of them lay less than twelve eggs to the set. This rate is very limited, especially when we consider that the destructive agencies in bird life are numerous. Beside the number of birds that are killed each season in migration, various animals depend largely upon birds for their existence. The young, too, require a definite period of time before they become sufficiently matured to perform a migration. Without here going into the principles of perpetuation, it is obvious that it is of importance to birds to return to their parental duties in spring as soon as possible. We do find it a quite general rule that several sets of eggs are hatched by one pair of birds each season, which shows the utter necessity of rearing the first brood as soon as possible. Furthermore, it is believed that birds experience a physiological restlessness at the approach of the breeding season, as a result of which they are led on to commence their migrations. (38.)

Thus we have a sufficient explanation for the rapid northward movement in spring so often interpreted as showing a desire to be among the familiar haunts of the past season.

Prof. W. K. Brooks, of Johns Hopkins University, presents us with an argument that is of quite another form. He holds with Prof. Baird that the main factors governing spring migration are to be sought among the enemies to breeding (39). There is no doubt that birds nest where there is apt to be the least danger from enemies. In fact, from the standpoint of natural selection we should expect this. Areas with conditions destructive to bird life during the breeding season have always been known to be local, and it would be a questionable inference to say that the south as a whole, or even only generally, is dangerous to breeding birds. Yet this inference is necessary for the conclusions derived by Prof. Brooks, since we have migration occurring in a most orderly manner between the north and south as a whole, except in a few special cases. These will be treated separately.

Prof. Brooks makes an analogy between the migrations of birds and those of fishes (40). An examination of the two phenomena will show that they are of quite a different order, and hence will permit of no just analogy. The fishes referred to migrate regularly at the approach of the breeding season. In spite of many hardships they migrate inland from the ocean, often for several hundred miles, into the tributary streams. Here the food supply is far below the demand, and the question of food as an explanation fails. The eggs are deposited and left to the care of nature. Prof. Brooks probably makes his point that this migration is purely a case of depositing eggs in some place safe from enemies. It is not, however, a movement into a fertile area, nor has it a general direction for the class. The course followed is one that will bring them to a desired local area. While fish migration is thus a local phenomenon (if it is not Prof. Brooks does not give us such an impression), bird migration is a widespread

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38. Stated by Merriam in a lecture delivered at the U. S. Nat. Museum, Apr. 3, 1886.

39. Brooks. Pop. Sc. Mo., vol. 52, p. 784.

40. For my facts concerning the migration of fishes I am indebted to Prof. Brook's Article.

phenomenon and operates between faunal areas. In general the two phenomena are thus of such an entirely different order that they will permit of no just analogy.

Among birds there are two classes of migrations that are local. In the tropics and the warmer portions of the temperate zones we have a movement into the mountains in spring, and back again in fall. These movements, although local, are obviously movements between faunal areas, and hence are similar to the general migrations. The other form of local migration is found among birds that spend most of their time roving over the sea. These birds breed in favored localities upon rocky islands. We have here a case somewhat analogous to the migrations of fishes. It is not a phenomenon operating between faunal areas. These cases Prof. Brooks has used as furnishing an argument against the failure of food in the south. He has failed to see, however, that the food supply of these birds and those of our more migratory species is found under entirely different conditions. The food of the former consists of material that is abundant about these rocky islands throughout the year. It is not affected by the dry season, and hence it is not necessary that these birds should perform such extended migrations.

In so far as migration is concerned in the extreme northern portion of the geographical distribution of a species, there is probably an analogy beween the movements of birds and those of fishes. When birds arrive in the north their movements are affected by local conditions. It is obvious that they will return to their old homes if these have been favorable; if not, they must seek new areas. It has been shown that the failure of food in the south will cause birds to move northward in spring. Investigations concerning migratory routes show that birds will be led back to the immediate vicinity of their old homes, where they seek breeding places that offer the best facilities. This latter portion of the movement may be analagous to that of fishes. The desire to secure safe breeding then becomes an important factor in migration, but only a modifying factor, a factor toward which we may look as a cause for the diversity and vastness which the phenomenon has attained. It may be one of the main factors concerned in the ultimate dispersion, and hence the increase of geographical distribution and extension of the migratory routes.

It has been shown that love of home and nesting ground, and the dangers of rearing young in the south, cannot be considered as principal causes for the spring migration. It has furthermore been shown that birds are quite dependent upon a particular kind of food, and that in the case of the migratory birds their food fails in the north in winter and in the south in summer. Hence we may be justified in saying that the principal cause for migration, both in spring and fall, is to be sought in the failure of food.

The period of migration, however, in each season is of at least four months duration.. In the spring it would seem that birds which arrive here find conditions for feeding less favorable than in the lands from which they have just departed. It has been shown, however, that it is advantageous for birds to return to their parental duties in spring as soon as convenient, and that the approach of the breeding season causes a physiological restlessness which sets them in migratory motion. In the fall, while we do find many of our birds departing at times when their food still seems to be abundant, we have life in nature continuously changing. Just as the year has seasons with a difference in life, so, too, the life of a summer is different at different times. Certain insects appear and disappear at more or less definite periods; plants, flowers, fruits and leaves all have their appointed times; days become longer and shorter, and the very atmosphere carries an essence, an inherent something, that seems to belong to a certain time of the summer. All of these phenomena are operating over a vast territory at the same time, affecting different birds in different ways, and setting countless numbers in motion simultaneously. While we may not be justified in saying that these changes in nature directly cause a dearth in the food supply of the migratory birds, they have been the forerunners, for ages past, of other changes the birds could not resist. Their influence upon birds has been operating since migration first took its origin, so that today they set the birds in motion instinctively.

Birds are set in migratory movement by a complex combination of changes in temperature, humidity and living nature. The cause for migration, however, is the failure of food in two widespread areas—the north and the south—at opposite seasons of the year.

CHAPTER III.

MIGRATORY ROUTES.

The theory that birds follow certain definite courses in their migrations, and that these courses are determined by the physiography of the countries through which they extend, may now be considered an established fact. A migratory route, excepting oceanic routes, consists of one or more physiographic features which together form an almost unbroken path from the breeding district of an individual to its winter home. These paths consist of coast lines, river valleys, mountain ranges and island chains. To illustrate, a bird may start somewhere near the Alleghany Mountains, follow a course along the Appalachian System to any one of the streams originating at its southern extremity, follow this to the coast and the coast to some point in Florida or the West Indies. Others might start somewhere along the tributaries of the Potomac or the Hudson River or the Merrimac, and then down the coast.

Whereas, we have single birds and small groups starting from wholly different places, many will be brought together over the same course; a number of such courses lead to larger ones, until we finally arrive at a physiographic area that is thronged with migrants. Such an area is known as a migratory highway.

It is quite generally accepted that the principal highways of North America are the Atlantic Coast, the Appalachian Mountain System, the Mississippi River Valley, the Rocky Mountain System, the Pacific Coast and an island chain extending across Cuba from Florida to Yucatan.

Topographic features of less extent may be considered tributary highways, or main highways for local areas. The Great Lakes of North America offer some peculiar conditions in the migrations of those birds that spend the summer north of them and the winter in the south. At the Straits of Mackinac we have a narrow neck where the land to the north and south of the Lakes is not separated by considerable areas of water. We have here a mere point in the geography of North America toward which innumerable birds converge in their flight from one side of the Lakes to the other. At Spectacle Reef light-house, which lies just east of the entrance into the straits, there have been upwards of four and five hundred birds killed in one night by flying against the tower.

How in general the topographic features of a district influence lines of migration is well known to all bird students. A careful study of the data presented in Prof. Cooke's Report on Migration in the Mississippi Valley shows, as we should expect, that birds resident in Wisconsin use the Mississippi River as a highway (41). Furthermore, after following this river north to the mouth of the Rock River, it is a noteworhy fact that immense numbers of our birds enter the state along a course following the Rock

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41. Cooke. Report on Bird Migration in Miss. Valley. U. S. Dept. Agr. Bull., No. 2, 1888.

River. A study of the movements of the bluebird north of St. Louis in the spring of 1885 shows that there is a regular chronological succession of data extending northward along the water courses (42). Another interesting feature is to be seen in the fact that those birds which followed the main highway reached higher latitudes in the same length of time than those which turned off to follow some tributary highway. It would thus seem evident that the birds reported from either side of the Mississippi River had been following it during some previous part of the journey. A study of the records of a number of the other birds has shown results that are very similar.

In connection with this work telescopic observations were begun at the Washburn Observatory at Madison, in the spring of 1898, and were continued through 1899 and 1900. During the spring of 1900 interested persons from our western universities were asked to co-operate in the collection of data. The result was excellent.

The following directions were sent to all who acknowledged their willingness to assist:

BIRD MIGRATION.

Directions for Observing with Telescope.

The Instrument.

Should be one with an objective ranging somewhere between 2 and 6 inches. The eye-piece should be supplied with 2, or if possible 4, hair-lines crossing in the center, thus dividing the field of vision into quadrants or octants.

Time of Observation.

Begin to observe as soon as the moon is high enough to come distinctly into the field of vision, and continue until morning.

To Begin the Observations.

Focus the telescope on the moon with the point of intersection of the hair-lines on the moon's center. Turn the eye-piece so that one of the lines lies parallel to the direction in which the moon is moving across the heaven. Now turn to your note paper. At the head of this write the date, locality, direction of wind, and weather in general. Just below this draw a circle, putting in the hair-lines as they appear through the telescope. Number them. beginning at the right hand side of the one you have placed parallel to the direction of the moon and continuing counter clock-wise. See figure below:

The Observations.

(It is a difficult task to observe and write out the observations at the same time, and, also, it will tire the eyes to look at the bright moon too

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42. The movements of the bluebird are recorded in Cooke's Report on pages 293 and 294.

long at one stretch. It is, therefore, advisable to have two observers so as to relieve each other every half hour or even every fifteen minutes, the one writing the observations while the other is observing).

The time should be divided into periods of fifteen minutes each, *i. e.*, the observations should be made for periods of this length.

The following data should be noted with every bird that crosses the field of vision:

The number and approximate tenths (as indicated by the hair-lines) at which the bird enters and likewise at which it leaves the field of vision.

The speed at which it is flying—slow, fast, like a shot, etc., etc.

His approximate size as compared to Goldfinch (size 1), Robin (size 2), and Crow (size 3). If slightly smaller add — sign, if larger a + sign.

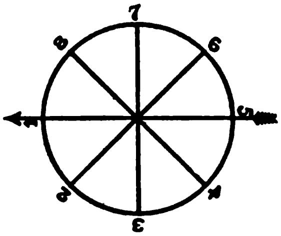
State if the bird is out of focus.

State if its wing-strokes are plainly seen.

Other remarks that you may think of value.

The notes should look like this:

Madison, Wis., May 14, 1900. Warm, with quite strong southwest wind; sky perfectly clear.



Period, 8:15—8:30.

I. In.	II Out.	III. Speed.	IV. Size.	Remarks.
				....
...	...	.....	....	....
4.6	1.2	very slow	2	Small hawk soaring.
3.8	8.1	fast	1	Flight like goldfinch.
3.8	8.1	fast	1	Flight like goldfinch.
5.2	8.8	very fast	1	....
4.1	8.5	fast	2	Curved below center.

III. and IV. are of less importance than I. and II.

These instructions resulted in eight excellent sets of data, and much credit is due Mr. Leon J. Cole of Ann Arbor, Faculty University of Michigan; Mr. H. S. Warren, of Detroit, Secretary Michigan Ornithological Society; Mr. William James Rice, Faculty Lake Forest University; Mr. O. S. Dart, student University of Minnesota, and Mr. Wegemann, student Beloit College, and their assistants, for their hearty co-operation in the collection of these data. A set consisting of one evening's observations was contributed from each of the following places: Ann Arbor, Detroit and Minneapolis; from Lake Forest there were two; and the writer, with the assistance of Mr. Wegemann, obtained three at Beloit, while Dr. Libby conducted the observations at Madison. The data received from Michigan deserve special mention for the care with which they were collected.

From the telescopic observations it appears that birds are quite, we might even say, exceptionally dependent upon their respective migratory routes. Curves drawn from such data representing the numbers of birds flying in periods of fifteen minutes show that physiographic features are followed very closely as guide-lines (Plate I.). The Beloit curves show a sudden increase in the numbers of birds observed as the telescope gradually comes to point more nearly over the course of the Rock River. The observatory at Beloit is situated on a slight elevation just east of the river, so that the telescope points away from the river in the early evening. The river at this point flows very nearly south, while just outside of the southern border of the city it takes a course a little west of south. These curves again show the extreme importance of a water course in migration. In the foregoing consideration it has been stated that a great many of the birds of Wisconsin enter the state along the course of the Rock River. The difference between the number of birds flying over the immediate course of the river and those flying to one side of it, as shown by the plates, indicates that topographical lines are followed very closely here. There is an ~~exceptional~~ concentration of the number of birds flying over the immediate course of the river.

While the curves drawn for Madison do not bring out this feature in as striking a contrast as do those for Beloit, the observations show that there is a decrease in the number flying when the field of observation has passed beyond the Madison Lakes and and Yahara River System. By reducing the different plots for Madison to the same number of hours after moon-rise, we obtain a comparative view of the numbers of birds flying over the same physiographic features (Plate II.). Although the curves show considerable diversity, they seem to reach maximum points between two and three, four and five, and seven and eight hours after moon-rise. This, however, is not universally true. The lake region about Madison, with its extremely diverse topographical features, makes the problem a most complex one in this region. From investigations carried on here for over four years it is quite safe to conclude that the greatest flights are found to occur when the telescope points over the lake system—that is, before the moon has traveled over the sky a distance of five hours. Plate III., which shows the observations of three evenings combined into a single plot, brings out this feature most strikingly.

In the first observations collected here the general conclusion suggested itself that birds discontinue their migrations soon after midnight, but the comparison of these observations with those from other places points to the conclusion that the topography rather than the time of night determines the number of birds flying.

If the curves drawn from data collected at Detroit, Michigan (Plate I.) are compared with the map of Michigan, it will be seen that the maximum of the curve is reached as the telescope points more nearly along the course of the Detroit River. The telescope used was situated about three-fifths of a mile from the river, on the western side. During the early part of the evening the insrument pointed over the river at an angle; toward 10 o'clock it gradually came to point along the course of the river, and then gradually moved away from the river again. The curve shows a more or less general increase toward 10 o'clock and a gradual decrease after that time, until it finally falls even lower than in the early part of the evening, when the telescope pointed across the river.

At Ann Arbor the map of Michigan shows the river so situated with reference to the place of observation that we might expect the highest point in the curve in the early part of the evening. It begins high and falls gradually as the telescope moves away from this area (Plate I.).

The topography surrounding Lake Forest, Illinois, makes the conditions influencing the migratory movement much the same as those for Detroit. Lake Forest is situated on the southwest shore of Lake Michigan. During the early part of the evening the telescope cuts the shore line of the lake at an angle; later it points more nearly in a line with the shore, after which it gradually moves away from this area again. These are in general the same conditions that prevail at Detroit, and the curves for the two places are, as we should expect, almost precisely the same. The time of observation at Lake Forest extended only to 11 o'clock; we might predict, however, that were they continued the curve would fall considerably lower (Plate I.).

The Detroit data show other interesting features that conform entirely with the theory here advanced. Out of 111 birds observed 74 were traveling northeast, 13 north-northeast, 11 east-northeast, 4 north, 5 north-northwest, 3 northwest, and 1 southeast. In other words, 66 2-3 per cent of all the birds recorded were flying northeast and about 21 2-3 nearly northeast, leaving only about 12 per cent that did not take a general northeasterly direction. The course of the Detroit River is southwesterly, and Mr. H. S. Warren writes that it seems evident that the birds were following the river. The regularity of the direction maintained should dispel all doubts to the contrary. An interesting feature now presents itself in connection with the peculiar topography just northeast of Detroit. The river here gradually broadens to form Lake St. Clair. While 66 2-3 per cent of the birds maintained a northeast direction, 21 2-3 diverged slightly to either side in about equal proportion, from which we might infer that the latter were beginning to direct their courses along opposite shore lines of Lake St. Clair. If this be the case, it shows how very closely birds follow topographic lines. Then, again, it is rightly maintained that birds can see great distances, from which we should expect that unless they follow the coast lines of the lake very closely the telescopic observations collected here would show a great diversiy in the directions of flight, since the birds would then cross from Lake Erie to Lake St. Clair rather promiscuously. Under such circumstances there would be very little evidence of concentration along special topographical lines.

A comparison of the plots for Beloit and Madison show that at Beloit the maximum in the curve is reached much more suddenly than at Madison (Plates I. to III.). This, again, according to our theory, is readily explainable in each case by the difference in the surroundig topography. The Lake System at Madison is broad and has the topographic features that influence lines of migration extending over a wide area. The Rock River at Beloit is narrow and the surrounding topography rather uniform. The curves for the latter place consequently rise more suddenly and at the same time vastly higher, the migrating stream being confined to narrower limits.

The birds noted to either side of the more important physiographic features are probably such as have departed from the main highway and are following courses of lesser importance, in many instances such as will probably lead them to a summer home in the vicinity. In fact, Plates IV. and V., illustrating the direction of flight at Beloit, seem to show that outside of the main highway (i. e., during the early part of the evening, when the telescope pointed away from the river) there is greater diversity in the directions followed. When the telescope points away from the main highway, the fact that fewer birds were seen and that the directions followed were more diverse would point to the conclusion that these birds were following migratory routes of lesser importance.

A feature of special note in Plate VIII., showing the directions of flight at Madison, is that there are two general directions followed here. From the preceding discussion, in which it was found that physiographic features are followed very closely, we might infer that the peculiar lake topography about Madison has brought about these two general directions.

It is, however, noteworthy in the plate that of these two directions one predominates in April and the other in May, though the percentage of the May-flight, if we may refer to it by that name, is not as marked over the April-flight in May as in the latter over the May-flight in April. Of the more common migratory species of this region something over 70 per cent of those that arrive here in April, and perhaps the first few days in May, are summer residents. Of those that arrive after that time about 60 per cent are mere migrants for this region; that is, they pass through here to breed farther north. Since these figures are only rough estimates, and furthermore would need to be modified considerably by the abundance of the number of individuals in the species, we can only hint at a possible interesting line of investigation that suggests itself here. It may be objected that this consideration is at present too vague even to allow of suggestion. However, if we take the list of one hundred species, with the dates of arrival and departure, prepared by Mr. F. M. Chapman (43), it will be seen that the percentages given above have not been overestimated in favor of the principle to be involved (44). About 64 of these 100 species arrive here before the end of the first week in May, and 36 after that date. Of the former, 52, or 81¼ per cent, are summer residents; of the latter, only 14, or about 38 8-10 per cent, are summer residents, the remainder breeding farther north. Moreover, the proportion of the number of individuals in those species that arrive here in May and are summer residents is in all but a few cases far below those that merely pass through here. Of fourteen summer residents that arrive here in May about eight are generally included among the rarer species, while only six are abundantly found, which would seem to show that in all probability the greater number of birds that fly through Madison in May breed farther north, and hence that different routes are followed by the two groups of birds.

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43. Handbook of Birds of East. N. A., N. Y., 1897, pp. 15-17.

44. This list has been slightly modified by notes taken in Wisconsin in recent years.

The topography to the north of Madison shows that Lake Mendota at one time had an outlet northwest into the Wisconsin River, and that a little to the northeast of this area there is a broad valley that once connected Rock River with Green Bay (45). A possible conclusion suggests itself now as an explanation of the two directions noted at Madison, namely, that they are the result of these two physiographic features.

These conclusions point to a feature of special interest which offers a most important field for investigation. In general the families Mniotiltidæ and Turidæ, and the order Limicolæ breed in the far north. Among the others certain species breed abundantly up to a definite latitude, beyond which the number of species and individuals of these more southern birds decreases directly as the distance increases. Granting Weismann's theory in so far as migration is a development, resulting from dispersion, as we must, and Merrian's theory that there are two centers of dispersion in North America (46), it would seem evident from the foregoing considerations that birds dispersing from the north southward, in the same region, may have been influenced by different topographic features from those that dispersed from the south northward.

From a detailed study of the geographic distribution of birds, their lines of migration, and the degree of perfection which the phenomenon has attained in the different groups, we may arrive at data which will lead to the correct conception of the origin of migration, and from which we may even be enabled to work out the evolution of the phenomenon in the different groups.

Prof. Baird has traced the lines of dispersion of a number of birds of eastern North America westward and northward, almost to the Pacific Coast in the northern part of the United States. He found that in dispersing they followed the Missouri and Platte Rivers from the Mississippi River and, what is most remarkable, that they followed these same rivers in migrating from these summer homes to their winter homes in Mexico, instead of moving directly southward through California (47). This is excellent evidence that the routes followed in migration are the lines of dispersion followed when birds first moved out from their original faunal area. Moreover, the main highways at present are situated along courses that are especially favorable as lines

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45. Chamberlin. Geol. of Wis. Survey of 1873-1879, vol. 1, p. 284.
46. Merriam. U. S. Dept. of Agri., North Amer. Fauna Bull., No. 3, pp. 19-22.
47. Baird. Am. Jour. of Sc., 1866, p. 78.

of dispersion, or where on account of barriers these courses would be the only ones likely to be followed. Thus the wooded streams of our river valleys and the salt marshes of the coast line offer an abundant supply of food, and quite generally environmental conditions that are favorable to birds of every group. Coast lines furthermore present the ocean on one side as a vast barrier; likewise island chains, while they present a favorable food supply on the one hand, have the ocean to either side as a vast barrier. Mountain ranges, again, with their difference in faunal areas, act as a barrier to certain groups, directing their movements along the more fertile foothills; as an inducement to others since they are enabled to find their accustomed faunal areas winding their way through other faunal areas that would be anything other than an inducement.

It now becomes evident that birds will return to the proximity of their old homes even in the absence of home affection.

The fact that some few birds seem to follow a different course in fall from the one followed in spring might at first appear to offer difficulties to the principle evolved above. If it be remembered, however, that migration originated as a result of dispersion, and in all probability of successive dispersions of the same species both from the north and the south, it is obvious that in the south different physiographic features may have influenced the birds from those that influenced them in the north, and so lead to a circular route. These cases must not be confused with those referred to by Prof. Baird, since in the latter the birds were already extensive migrants, they were beyond the stage of the acquisition of the habit, and present us merely with a case of the extension of a migratory route under conditions already familiar to them.

In connection with work of this nature two theories have been presented, at different times, regarding a sixth sense by means of which birds find their way between their summer and winter homes. The first of these, that of Dr. A. von Middendorf, has already been shown to be a fallacy (Historical Review, pp. 4-5, *ante*). The second is the result of careful investigations upon carrier pigeons. Capt. G. Reynaud, who is the author of this theory, has formulated what he terms a "law of retracement," or "law of reverse scent" (48). He says: "When the time for departure is come, birds of the same species, inhabitating the same region, come together for the journey. Those that have already

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48. **Smithsonian Report, 1898, pp. 481-498.**

made the voyage take the lead and retrace the path by which they came (49). The younger birds, born since the last journey, confine themselves to following their elders, and when, some months, later, it becomes time to return, they are able in their turn to follow in a reverse direction the journey previously made."

However, since migration is the result of dispersion, and dispersion takes place very gradually, comparatively only a very short distance each year in the extension of a migratory route, the probabilities are that the features along this route are very familiar to the older birds. With regard to those that were born since the last journey, there are again conditions that make a sixth sense entirely unnecessary. Brewster claims that young birds migrate by example, and his claims are upheld by the majority of leading ornithologists (50). This being the case they can readily join the migrating stream overhead and without any great effort follow the general movement. When we consider that at Beloit from sixty to eighty birds crossed the field of vision in fifteen minutes, showing that there is a regular stream of migrants along the highway, it leaves little room for doubting the ability of young birds to find their way without the aid of a sixth sense.

CHAPTER IV.

THE MANNER OF MIGRATION.

The movements and habits of birds differ in different species, during the migratory season, with regard to one another and to their environment. These relations have been designated by the term Manner of Migration.

The problems arising in this connection may be classified under three main heads: (1) with regard to their associations, which concerns itself with the questions of the numbers and species associated during the migratory season, the relation of adults to young, and the relation of males to females; (2) with regard to the environment, which concerns itself with the questions of special food habits, and meteorological influences; (3) with regard to the manner of progressing from place to place, which concerns itself with the time of migration—day or night,—the relative successive positions, the speed and altitude attained, and kindred phenomena exhibited during the time birds are in actual migratory motion. The following discussion will deal in the main with such of these problems as can be solved by means of the telescope supplemented by field observations.

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(49). This he endeavors to show is accomplished by a sixth sense, a sense of orientation.

(50). Brewster. Mem. Nutt. Ornith. Club, No. 1, 1886, p. 12.

Numbers Associated in Migration.—It has been known for a long time that migrations occur both during the day time and during the night, but it is only within comparatively recent years that a fair conception of the extent to which the nocturnal migrations take place has been attained. Prof. A. S. Flint of the Washburn Observatory has calculated from data collected by Dr. O. G. Libby in 1897, that nine thousand birds per hour passed within the arc of a circle subtended by the angle through which the telescope passed during the entire period of observation. This gives us a fair mathematical estimate of the magnitude of the nocturnal movement.

The Altitude Attained in Migration.—Estimates of the altitude of migration as obtained by means of the telescope show that former investigators have placed their estimates far too high. In the observations taken at Beloit from 2:00 to 3:30 A. M. the telescope made an average angle of about fifteen degrees with the horizon. The telescope at this time was about one mile from that portion of the river over which the birds were observed. This means that the majority of them were not over fifteen hundred feet above the surface of the earth.

Estimates from data collected at Detroit show the flight to have been slightly higher, but still far below the estimates of former investigators. Mr. H. S. Warren writes from that place as follows: "The observations were taken at the Cartwright observatory located about three-fifths of a mile from the river. The telescope, a 6-inch refracting instrument, equatorially mounted with an 8-inch focus, was at an average angle during the period of observation, of about thirty degrees. If the birds that were traveling northeast, which numbered considerably more than one-half of all noted, were following the course of the river, which seemed evident, they must have been somewhat more than one-half mile above the surface."

The telescopic observations show that there may be a zone of considerable depth, birds choosing variable altitudes in which to perform their migrations, but by far the greater number do not attain an altitude much over one-half mile from the earth's surface.

Associations of Individuals and Species.—A more detailed consideration of the telescopic observations collected for this thesis tends to establish, with some modifications, the results obtained by

Dr. Brewster at Point Lepreaux Light-house in 1881 (51). No set of data or description can convey so good an idea of the actual state of affairs as the observation of the phenomena themselves through the telescope. With regard to nocturnal migrants the following general conclusions are apparent: (1) that they perform their journeys both singly and in compact flocks, the different individuals and groups being more or less united into straggling bands or streams; (2) that single individuals and groups fly independent of one another, but to some extent may be dependent upon the general movement of the stream; and (3), that there is a great diversity of species and individuals associated together in migration.

The data for any one evening that has seemed favorable for migrating birds will establish these general statements. (See data in appendix.) The continuous stream-like movement over some routes has already been referred to and it will only be necessary to call attention here to the extent of these bird-streams, and to the fact that they are composed both of single individuals and flocks. Throughout the observations when the number of birds was not exceptionally large, from two or three to about fifteen for a period, it was very noticeable that the majority of birds were not collected into compact flocks. Although it was not uncommon to have several appear in fairly rapid succession, it was more often the rule to see them following one another in a straggling manner: impressing the observer with the idea of a regular straggling stream, such as one might see anywhere near a school just after the hour of dismissal.

From the entire set of observations collected with the telescope, the immense numbers of birds recorded when the field of vision extended along a highway, and the apparent regularity with which the birds passed—in some instances for several hours at a time,—it is quite evident that along the main highways and the more important tributaries birds fly in such numbers that for miles we have one long, almost continuous stream of birds. When we consider that from fifty to eighty birds were recorded on the Rock River in fifteen minutes, that the average number remained high for more than an hour, and that these birds must have departed from a similar stream of even greater magnitude along the Mississippi River, the nocturnal movement becomes not merely interesting but marvelous.

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51. Brewster. Mem. Nutt. Ornith. Club, No. 1, 1885.

Although Dr. Brewster has not found it so at Point Lepreaux, telescopic observations tend to show that certain individuals may be collected into fairly compact flocks, numbering from a few to a large number. Thus in the data collected at Beloit, May 12, 1900, from 1:45 to 3:00 A. M., there are five records (see appendix, pages 238 to 240) where birds appeared in comparatively large numbers, in such rapid succession—often a number in the field at the same time—that it leaves little room for doubting that these birds did belong to fairly compact flocks. To say that in some instances as many as ten or more birds crossed the field in less than one-third that many seconds would not be an overstatement of the case. Moreover, the actual number recorded must have been only a small number of all that were associated in one flock. In fact data obtained by listening for bird calls on dark nights seem to indicate that it is not an uncommon occurrence for nocturnal migrants to fly in fairly compact flocks.

That flocks and single individuals flying side by side, are moving independent of one another is evident from the range of speed exhibited. Throughout the observations it was common to see birds, at times, apparently side by side, flying at rates that varied from the extremely slow to the very highest rate of speed. On the other hand it is quite obvious that the general movement of the stream may have a guiding influence to such birds as have had little or no experience.

Although it is only in rare instances that species can be identified, the general outline, the size and the motion of the birds as they are seen silhouetted against the moon leaves little doubt to the observer that he has a diversity of species passing through the field of vision. The large number of routes that lead to the more important highways would bring individuals from diverse regions together along these courses. On the other hand, birds that become associated do not necessarily continue thus to the end of their journey. Dr. Brewster makes the following statement in this connection: "During even its earliest stages their members must become separated from one another and become associated with birds of the same or different species belonging to other flocks which may have started from various localities, but which are traveling in the same direction and along the same or parallel paths" (52).

As to how these birds separate again, Dr. Brewster says: "An answer to this question was suggested at Point Lepreaux by the

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52. Brewster. Mem. Nutt. Ornith. Club, No. 1, 1885, p. 13.

fact that, while many species of birds arrived together on the same night, and mingled indiscriminately in the neighboring woods during the following day, they did not invariably depart together nor in the same direction. This leads me to believe," he says further, "that similar places along every route constitute what may be called stations or points of departure" (53). Field observations about Madison show results that are very similar. A careful study of the movements of the tree sparrow and the slate-colored junco was made during the spring of 1900. Their haunts were visited each morning on the eastern border of Lake Wingra and on the University Drive along Lake Mendota. Each day there was either an increase or a decrease and it was plainly noticeable that there were several sets of individuals intermingled. From their actions it is quite easy to distinguish those that arrive the preceding night from those that were there the day before. These observations, however, would seem to indicate that such points of departure are not limited to promontories extending into the sea, points of timber bordering extensive plains or the extremity of mountain ranges, where the migrating tide hesitates before venturing on the dangerous stage ahead, as has been suggested by Dr. Brewster (54), and previously, in 1846, by J. F. Naumann (55). These investigations show that such stations may occur almost anywhere along a migratory route rather than at certain limited points.

Birds do not fly to some desired resting place in one night and then pursue their flight to another the next night, nor do they necessarily fly throughout the entire night and then stop at the first convenient place in the morning. The simple truth here is that birds fly as far during one night as they find convenient, the distance being determined by immediate environmental influences. In the observations made at Beloit there were certain times when there seemed to be an undue proportion of birds so close to the telescope that they appeared out of focus. The directions of flight of these individuals as illustrated by plates IV-VII are entirely out of keeping with the general course. A conclusion suggests itself here that these birds had departed from the migrating stream overhead and were seeking suitable resting places.

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53. Brewster, Bull. Nutt. Ornith. Club, No. 1, page 13.
54. Ibid.
55. Hist. Review, p. 180.

Appendix.

For the method of observation see pages 198 and 199. The meteorological data, except those for Detroit, Ann Arbor, and Lake Forest, have been taken from the records at the Washburn Observatory at Madison. The temperature in each case is for 9:00 P. M., the direction of the wind for 2:00 and 9:00 P. M., stated for example West to Northwest—West at 2:00 and Northwest at 9:00 P. M. When only one direction is given that was the direction for the entire day.

Madison, Wis., April 9, 1898.

Meteorological Data.

Wind—North Northwest, velocity 5.
Temperature —44. 3°.
Atmosphere—sprinkling at 2:00 P. M., fair at 9:00.
Total number of Birds observed from 9:45 P. M. to 11:30 P. M.—44.

9:45 to 10:00—in 3.0—out 5.0.
in 3.0—out 7.0.
in 3.0—out 8.0.
in 4.0—out 7.0.
in 3.0—out 8.0.
in 4.0—out 6.0.
in 3.0—out 8.0.
in 4.0—out 8.0.
in 3.0—out 8.0—Total 9.
10:00 to 10:15—in 3.0—out 7.0—Robin.
in 3.0—out 7.0—out of focus.
in 2.0—out 7.0.
in 2.0—out 6.0 }
in 2.0—out 7.0. } Geese side by side.
in 3.0—out 8.0.
in 3.0—out 7.0.
in 3.0—out 5.0.
in 3.0—out 8.0—Total 9.
10:15 to 10:30—in 2.0—out 8.0.
in 2.0—out 8.0.
in 2.0—out 7.0.
in 1.0—out 5.6.
in 3.0—out 8.0.
in 3.0—out 7.8.
in 3.0—out 5.0.
in 2.5—out 8.9.
in 3.7—out 5.5—Total 9.
10:30 to 10:45—in 3.7—out 6.9.
in 2.0—out 8.0.
in 3.5—out 6.5.
in 4.3—out 7.7.
in 1.5—out 7.7.
in 3.5—out 8.5.
in 5.1—out 7.5.
in 3.0—out 1.0.
in 3.1—out 5.7.

in 5.7—out 7.0.
in 2.9—out 7.8.
in 3.5—out 6.3.
in 4.2—out 5.6—Total 13.
10:45 to 11:00—in 8.0—out 6.0.
in 3.3—out 7.5.
in 2.6—out 7.6—Total 3.
11:00 to 11:15—in 0.0—out 0.0—Total 0.
11:15 to 11:30—in 2.5—out 7.6—Total 1.

MADISON, WIS., Apr. 10, 1898.

METEOROLOGICAL DATA.

Wind—North to northwest, velocity 4.
Temperaure—45. 8°.
Atmosphere—Cloudy at 2 P. M. to clear at 9 P. M.
Total number of birds observed from 12:45 P. M. to 3:00 A.M.—6.

12:45 to 1:00—in 0.0—out 0.0—Total 0.
1:00 to 1:15—in 3.5—out 8.6—Slow—Size 1—Total 1.
1:15 to 1:30—in 3.1—out 8.2—Out of focus—Total 1.
1:30 to 1:45—in 4.4—out 8.1—Total 1.
1:45 to 2:00—in 3.2—out 7.9—Flying leisurely.
in 3:5—out 7.2—Faster—Same species as preceding—Total 2.
2:00 to 2:15—in 0.0—out 0.0—Total 0.
2:15 to 2:30—in 5.2—out 7.9—Total 1.
2:30 to 2:45—in 0.0—out 0.0—Total 0.
2:45 to 3:00—in 0.0—out 0.0—Total 0.

MADISON, WIS., May 5, 1898.

METEOROLOGICAL DATA.

Wind—North to southeast, velocity 4.
Temperature—46. 5°.
Atmosphere—Cloudy to clear.
Total number of birds observed from 8:30 P. M. to 11:00 P. M.—13.

8:30 to 8:45—in 4.5—out 6.5—Slow — Long wing-strokes—Sailing.
in 4.4—out 7.3—Out of focus—8 minutes of this period missed—Total 2.
8:45 to 9:00—in 0.0—out 0.0—Total 0.

9:00 to 9:15—in 4.5—out 7.6.
in 1.5—out 6.0—Total 2.
9:15 to 9:30—in 0.0—out 0.0—Total 0.
9:30 to 9:45—in 1.9—out 6.0.
in 1.5—out 5.5—3 or 4 ducks in line—Out of focus.
in 5.3—out 7.8—Duck—Out of focus.
in 2.3—out 3.7—Duck—Out of focus—Total 7.
9:45 to 10:00—in 2.5—out 7.3—Duck—Out of focus—Total 1.
10:00 to 10:15—in 1.5—out 4.3—Swift, with speed of a shot—Total 1.
10:15 to 10:30—in 0.0—out 0.0—Total 0.
10:30 to 10:45—in 0.0—out 0.0—Total 0.
10:45 to 11:00—in 0.0—out 0.0—Total 0.

MADISON, WIS., May 6, 1898.

METEOROLOGICAL DATA.

Wind—North to southeast, velocity 5.
Temperature—49. 2°.
Atmosphere—Clear.
Total number of birds seen from 9:45 P. M to 11:00 P. M.—8.

9:45 to 10:00—in 4.7—out 6.7—This period cloudy about 7 min.
in 4.6—out 7.8—Heron—Total 2.
10:00 to 10:15—in 4.3—out 7.2—This period cloudy about 3 min.
in 2.5—out 5.3—Total 2.
10:15 to 10:30—in 2.4—out 5.2.
in 2.6—out 5.3—Total 2.
10:30 to 10:45—in 8.8—out 7.6—Total 1.
10:45 to 11:00—in 8.8—out 4.8—Total 1.

MADISON, WIS., August, 1898.

(Meteorological data incomplete on account of date missing.)

Total number of birds observed from 11:00 P. M. to 12:30 P. M.—33.

11:00 to 11:15—in 8.5—out 3.5.
in 7.5—out 3.8—Size 2.
in 7.5—out 3.8.
in 7.5—out 4.2.
in 7.5—out 3.6.
in 6.7—out 3.0—Size 2.

in 6.3—out 4.5.
in 6.5—out 4.8—Total 8.
11:15 to 11:30—in 7.1—out 3.2—Total 1.
11:30 to 11:45—in 7.3—out 3.4.
in 6.3—out 3.2.
in 6.7—out 3.8.
in 8.3—out 2.4.
in 6.4—out 4.2.
in 7.3—out 3.0.
in 6.4—out 3.7.
in 6.5—out 2.5.
in 6.8—out 3.9.
in 7.3—out 3.4.
in 6.1—out 3.3.
in 6.3—out 4.5—Total 12.
11:45 to 12:00—in 5.5—out 3.1.
in 5.9—out 2.1.
in 6.5—out 3.5.
in 6.9—out 3.2.
in 5.4—out 3.1.
in 5.0—out 2.3—Total 6.
12:00 to 12:15—in 6.7—out 1.2.
in 6.5—out 2.3.
in 6.4—out 4.1—Total 3.
12:15 to 12:30—in 6.4—out 3.2.
in 5.4—out 3.2.
in 5.5—out 2.5—Total 3.

MADISON, WIS., Sept. 24, 1898.

METEOROLOGICAL DATA.

Wind—West to southwest, velocity 4.
Temperature—63. 3°.
Atmosphere—Cloudy to clear.
Total number of birds observed from 7:15 P. M, to 11:30 P. M.—46.

7:15 to 7:30—in 6.3—out 3.6—Total 1.
7:30 to 7:45—in 4.2—out 2.1.
in 3.5—out 2.6.
in 5.9—out 7.9.
in 5.5—out 8.3.
in 5.8—out 3.9.

in 6.8—out 2.1 } Slow—Same species—meadowlark(?).
in 5.3—out 7.1 } Fast
in 4.6—out 1.8.
in 5.9—out 3.8—Very slow—About 3 sec. to cross field.
in 5.9—out 1.1—Total 10.
7:45 to 8:00—in 4.5—out 2.1.
in 5.3—out 2.5—Total 2.
8:00 to 8:15—in 5.5—out 1.1.
in 4.8—out 2.8.
in 4.8—out 1.9.
in 5.3—out 2.7.
in 5.0—out 1.8.
in 0.0—out 3.1.
in 4.5—out 2.6.
in 5.3—out 2.2—Total 8.
8:15 to 8:30—in 6.8—out 0.0—Curved over center.
in 6.2—out 8.9—Total 2.
8:30 to 8:45—in 4.3—out 2.0.
in 5.3—out 8.9—Like a shot.
in 4.6—out 1.5.
in 5.8—out 1.3—Total 4.
8:45 to 9:00—in 6.2—out 1.8 }
in 4.4—out 1.8 } Same species.
in 6.2—out 1.5 }
in 6.4—out 1.2.
in 4.5—out 1.1—Total 5.
9:00 to 9:15—in 6.0—out 1.5.
in 4.6—out 2.9—A mere blur.
in 4.6—out 1.6.
in 5.8—out 1.1—Swift, like a shot.
in 8.0—out 3.6—Total 5.
9:15 to 9:30—in 0.0—out 0.0—Total 0.
9:30 to 9:45—in 6.3—out 8.4.
in 7.1—out 3.8.
in 3.7—out 8.9—Total 3.
9:45 to 10:00—in 0.0—out 0.0—Total 0.
10:00 to 10:15—in 5.5—out 8.6.
in 2.5—out 5.8—Total 2.
10:15 to 10:30—in 0.0—out 0.0—Total 0.
10:30 to 10:45—in 5.8—out 7.8.
in 1.9—out 3.8.

in 5.0—out 1.0—Total 3.
10:45 to 11:00—in 0.0—out 0.0—Total 0.
11:00 to 11:25—in 0.0—out 0.0—Total 0.
11:25 to 11:50—in 4.6—out 2.4—Total 1.

MADISON, WIS., Sept. 25, 1898.

METEOROLOGICAL DATA.

Wind—South, velocity 8.
Temperature—63. 6°.
Atmosphere—Clear.

Total number of birds observed from 6:45 P. M. to 8:55 P. M.—2.

6:45 to 7:00—in 0.0—out 0.0—Total 0.
7:00 to 7:15—in 0.0—out 0.0—Total 0.
7:15 to 7:30—in 5.0—out 1.0.
in 7.3—out 5.6—Total 2.
7:30 to 7:45—in 0.0—out 0.0—Total 0.
7:45 to 8:00—in 0.0—out 0.0—Moon partly obscured by clouds—Total 0.
8:00 to 8:15—in 0.0—out 0.0—Total 0.
8:15 to 8:30—in 0.0—out 0.0—Total 0.
8:30 to 8:45—in 0.0—out 0.0—Total 0.
8:45 to 8:55—in 0.0—out 0.0—Total 0.

MADISON, WIS., Apr. 25, 1899.

METEOROLOGICAL DATA.

Wind—North northwest to southeast.
Temperature—66. 8°.
Atmosphere—Clear.

Total number of birds observed from 8:37 P. M. to 11:30 P. M.—7.

8:37 to 8:45—in 3.8—out 8.9—2 birds at high speed.
in 4.1—out 8.5.
in 3.9—out 8.5—Curved below center—Total 4.
8:45 to 9:00—in 0.0—out 0.0—Total 0.
9:00 to 9:15—in 0.0—out 0.0—Total 0.
9:15 to 9:30—in 4.2—out 7.8.
in 2.0—out 5.0—Slow—Wing-beats slow—Total 2.
9:30 to 9:45—in 0.0—out 0.0—Total 0.
9:45 to 10:00—in 0.0—out 0.0—Total 0.

10:00 to 10:15—in 0.0—oue 0.0—Total 0.
10:15 to 10:30—in 7.6—out 1.3—Total 1.

MADISON, WIS., May 22, 1899.

METEOROLOGICAL DATA.

Wind—Northeast to east southeast, velocity 4.
Temperature—54. 8°.
Atmosphere—Clear.
Total number of birds observed from 8:30 P. M. to 10:45 P. M.—61.

8:30 to 8:45—in 0.0—out 0.0—Direction missed.
in 8.6—out 3.5.
in 1.0—out 5.0—Flight like meadowlark.
in 2.6—out 7.4—Same as preceding.
in 1.0—out 5.4.
in 4.0—out 5.0—Total 6.
8:45 to 9:00—in 4.5—out 7.5.
in 3.0—out 8.0.
in 4.5—out 7.5—Sailing.
in 6.0—out 8.5.
in 4.5—out 6.0—Curved around center.
in 5.0—out 7.0.
in 8.0—out 6.0—Size 3.
8:45 to 9:00—in 2.0—out 6.0—Dropped through Field—Total 8.
9:00 to 9:15—in 4.0—out 0.0.
in 1.0—out 5.0.
in 2.0—out 4.5.
in 7.0—out 5.4.
in 7.2—out 0.0.
in 3.7—out 8.5.
in 8.5—out 6.0.
in 6.5—out 4.5—Total 8.
9:15 to 9:30—in 3.6—out 7.0.
in 1.0—out 5.0.
in 8.5—out 5.2.
in 3.5—out 8.0—Out of focus.
in 1.0—out 5.2.
in 1.0—out 5.0—Sailing in the wind—Total 6
9:30 to 9:45—in 1.0—out 4.8.
in 4.3—out 8.5—Swamp blackbird(?).
in 4.5—out 8.5.

in 0.0—out 0.0—Pigeon(?), long, pointed tail.
in 3.8—out 1.5.
in 8.5—out 7.1.
in 7.0—out 1.0—Out of focus—Total 7.
9:45 to 10:00—in 7.3—out 3.7—Curved over center.
in 8.5—out 5.0—Robin(?).
in 8.5—out 7.0.
in 1.5—out 7.0—Out of focus.
in 8.6—out 4.5
in 1.0—out 4.5 } Same species, brown thrush(?)
in 8.5—out 4.5
in 0.0—out 0.0—6 minutes lost—Total 7.
10:00 to 10:15—in 0.0—out 0.0—8 minutes lost.
in 1.0—out 3.5.
in 1.5—out 5.0.
in 8.5—out 5.0—Curved below center.
in 7.5—out 5.0—Swift—Snipe(?).
in 8.7—out 7.0—Snipe(?).
in 8.5—out 4.8—Out of focus—Total 6.
10:15 to 10:30—in 7.5—out 5.0.
in 8.5—out 4.5.
in 8.3—out 4.8.
in 8.7—out 4.8.
in 1.3—out 3.5—Size 1.
in 4.3—out 2.0.
in 8.9—out 3.0—Long tail.
in 8.9—out 3.5.
in 8.5—out 4.8—Swift, speed like a shot—Total 9.
10:30 to 10:45—in 1.0—out 4.0.
in 1.0—out 5.2.
in 7.0—out 5.0.
in 1.0—out 4.0—Duck—Total 4.

MADISON, WIS., Apr. 10, 1900.

METEOROLOGICAL DATA.

Wind—North northeast to east, velocity 6.
Temperature—29. 2°.
Atmosphere—Cloudv to clear.
Total number of birds seen from 8:00 P. M. to 9:15 P. M.—0.
No birds seen for the entire evening.

MADISON, WIS., Apr. 18, 1900.

METEOROLOGICAL DATA.

Wind—Northwest to southeast, velocity 4.
Temperature—46. 8°.
Atmosphere—Cloudy to clear.
Total number of birds observed from 11:15 P.M. to 1:15 A. M.—121.

11:15 to 11:30—in 3.9—out 8.1.
in 4.5—out 7.7.
in 4.0—out 8.3.
in 4.0—out 8.2—Size 2.
in 3.6—out 8.7—Curved up.
in 3.8—out 8.4—Curved up.
in 3.9—out 1.3.
in 3.5—out 8.6.
in 3.1—out 8.8
in 3.7—out 8.9—All the above birds are about the size of a robin.
in 4.7—out 8.6—Swift.
in 4.2—out 8.1—Curved down.
in 4.3—out 7.8.
in 3.1—out 2.3.
in 0.0—out 0.0—About one minute with no birds.
in 3.4—out 1.1.
in 4.9—out 6.9—Out of focus.
in 3.1—out 8.9.
in 0.0—out 0.0—Direction missed.
in 2.5—out 1.8.
in 4.3—out 8.3—Size 1.
in 3.4—out 1.2—Very slow.
in 3.6—out 8.2.
in 3.7—out 7.9—Followed preceding very closely.
in 3.9—out 7.9.
in 3.2—out 8.9.
in 3.2—out 1.3—Curved up.
in 3.8—out 8.2—Swift—Size 3—Fast flyer and of large size.
in 3.8—out 1.7.
in 3.8—out 8.9—Slow.
in 3.6—out 8.5.

in 4.1—out 7.9—Slow—Size 1—Wing-strokes plain.
in 0.0—out 0.0—No birds for 2 minutes.
in 4.1—out 8.8.
in 4.3—out 7.8—Total 33.
11:30 to 11:45—in 4.8—out 8.2.
in 4.1—out 2.1—Swift—Out of focus.
in 4.2—out 7.8.
in 4.0—out 8.0.
in 3.1—out 1.8 }
in 3.5—out 8.1 } These two passed close to one another.
in 5.8—out 1.1.
in 5.1—out 8.9.
in 0.0—out 0.0—Missed direction.
in 2.6—out 1.2 }
in 3.3—out 8.1 }
in 4.8—out 8.3 } All the same species.
in 3.2—out 2.6 }
in 4.0—out 8.0—Dove through the field.
in 3.5—out 8.9.
in 3.3—out 2.1.
in 2.1—out 1.2.
in 4.0—out 7.4.
in 5.0—out 6.9.
in 5.0—out 7.2.
in 4.3—out 8.2.
in 4.9—out 7.7.
in 3.3—out 1.0.
in 3.6—out 8.2.
in 4.0—out 7.1.
in 0.0—out 0.0—No birds for 2 minutes.
in 3.4—out 8.6.
in 3.7—out 8.2—Total 27.
11:45 to 12:00—in 4.2—out 7.5—Fast.
in 0.0—out 0.0—No birds for 2 1-2 minutes.
in 4.2—out 7.4.
in 3.8—out 7.8.
in 4.0—out 7.1—Swift—Size 3-|-.
in 4.0—out 6.5—Same species as preceding.
in 3.2—out 7.2.
in 4.2—out 6.8—Swift—Size 3-|-.
in 3.8—out 7.2.

in 4.2—out 6.0.
in 4.5—out 6.8.
in 2.8—out 7.8 } Same species.
in 3.2—out 7.5
in 2.0—out 8.1.
in 4.2—out 7.5.
in 3.0—out 7.3.
in 2.0—out 1.2.
in 4.5—out 6.5—Very slow—Total 17.
12:00 to 12:15—in 3.2—out 7.8.
in 4.1—out 7.2.
in 4.2—out 8.0.
in 4.0—out 7.6.
in 4.0—out 7.6—Size 3-|-.
in 4.2—out 8.0 } Slow—Flight like goldfinch.
in 4.5—out 6.5
in 4.2—out 8.1
in 6.0—out 7.5
in 3.7—out 7.8—Swift—Size 3-|-.
in 4.0—out 8.0 } In field at same time.
in 5.0—out 6.2
in 3.1—out 8.7
in 4.0—out 8.0—Size 3-|-.
in 3.2—out 8.7 } Flight like goldfinch.
in 4.8—out 7.2.
in 3.0—out 8.2—Total 17.
12:15 to 12:30—in 3.5—out 8.9—Swift.
in 3.8—out 8.2.
in 3.0—out 8.9—Size 3-|-.
in 5.7—out 7.9.
in 4.2—out 7.9.
in 0.0—out 0.0—No birds for 5 minutes.
in 3.8—out 8.3—Slow—Size 1—.
in 4.9—out 7.2—Fast—Size 3. Out of focus.
in 5.8—out 7.1—Flight like goldfinch.
in 5.0—out 2.1—Curved below center.
in 4.2—out 8.2.
in 5.0—out 1.2.
in 7.9—out 4.2—Sailed, like a meadowlark.
in 4.0—out 8.6—Swift—Size 1.
in 3.9—out 8.5—Slow—Size 1—Flitting carelessly criss-cross through field. He paused a second

as if to turn in his course. Total 14.
12:30 to 12:45—in 4.8—out 7.2—Swift—Size 2-|-.
in 7.8—out 3.0—Slow—Looked like duck.
in 3.0—out 7.0.
in 5.0—out 7.2—Seemed to appear suddenly near center of field.
in 4.5—out 8.5—Size 3.
in 2.0—out 8.8—Total 6.
12:45 to 1:00—in 2.0—out 8.8—Total 1.
1:00 to 1:15—in 4.6—out 7.9—Out of focus.
in 3.4—out 1.9—Swift—Out of focus.
in 3.1—out 8.9—Out of focus—Sailing.
in 5.6—out 7.2—Fast—Out of focus.
in 2.9—out 0.0—Slow.
in 3.2—out 8.5—Slow, wing-strokes visible—Out of focus.
in 3.3—out 1.9—Slow, wing-strokes visible—Out of focus—Total 7.

MADISON, WIS., May 9, 1900.

METEOROLOGICAL DATA.
Wind—South to southwest, velocity 8.
Temperature—53. 9°.
Atmosphere—Clear.
Total number of birds observed from 7:50 P. M. to 11:45 P. M.—47.

7:50 to 8:00—in 0.0—out 0.0—Total 0.
8:00 to 8:15—in 5.8—out 3.8—Out of focus.
in 5.1—out 1.6—Slightly blurred—Total, 2.
8:15 to 8:30—in 0.0—out 0.0—Total 0.
8:30 to 8:45—in 8.9—out 5.3—Slow—Size 2—Wing-strokes seen—Total 1.
8:45 to 9:00—in 5.0—out 7.0—Fast—Out of focus, obscured over 60 per cent of field.
in 4.8—out 7.1—Size 1-|-. Slightly blurred—Total 2.
9:00 to 9:15—in 4.1—out 7.7—Fast. Out of focus. Strokes visible.
in 2.2—out 3.6.—1-|-. Very distinct. Total 2.
9:15 to 9:30—in 8.4—out 7.3.—Size 1. Wing-strokes visible.
in 3.3—out 1.2.—Swift. Size 2—Out of focus. Total 2.

9:30 to 9:45—in 8.6—out 6.5.—Size 1-|-.
in 1.2—out 7.3.—Size 3. Slow strokes, little blurred.
in 4.2—out 7.1.—Same species as first bird of 9:00 to 9:15 period. Total 3.

9:45 to 10:00—in .2.2—out 1.5.—Swift. Size 1-|-.
in 1.7—out 3.4.—Size 1—. Wind rising at 9:50. Total 2.

10:00 to 10:15—in 2.0—out 4.2.—Slow. Size 2-|-.Wing-strokes visible.
in 3.7—out 8.5.—Size 2-|-. Slightly out of focus. Total 2.

10:15 to 10:30—in 4.1—out 2.5.—Fast. Size 1. Total 1.

10:30 to 10:45—in 2.6—out 7.7.—Fast. Size 2—. Wing-strokes visible.
in 2.9—out 3.5—.Flock of 5 ducks parallel to 2.9 to 3.5.
in 4.4—out 7.1.—Size 2-|-. Wing strokes fast.
in 2.6—out 4.9.—Slow. Size 2-|-. Wing-strokes fast.
in 2.8—out 4.9.—Slow. Size 2-|-. Wing-strokes slow, sailing. Same species. Total 10.

10:45 to 11:00—in 2.0—out 6.2.—Size 2.
in 3.0—out 6.0.—Size 3. Out of focus.
in 1.3—out 7.4.—Size 2. Wing-strokes plain. Total 3.

11:00 to 11:15—in 2.2—out 5.9.—Size 1—. Sailed through field.
in 1.2—out 5.6.—Much out of focus.
in 5.0—out 7.0.—Size 1—.
in 1.9—out 6.2.—Size 2. Looked like blackbird.
in 2.5—out 4.7.—Size 2. Looked like blackbird.
in 3.2—out 5.5.—Size 3. Duck. Total 6.

11:15 to 11:30—in 4.8—out 6.8.—Size 3. Out of focus.
in 3.4—out 6.5.—Fast. Size 1-|-. } Same
in 2.0—out 5.9.—Fast. Size 1-|-. } species.
in 1.2—out 5.7.
in 2.3—out 4.8.
in 4.8—out 7.1.—Out of focus.
in 2.1—out 5.1.—Size 2. } Same species.
in 2.2—out 4.8.—Size 2. }
in 3.8—out 8.0.—Last one out of focus. Total 9.

11:30 to 11:45—in 3.4—out 6.7.—Large wings; flight like bat.
in 2.8—out 6.4.—Tiny wing-strokes; body large. Total 2.

MADISON, WIS., May 10, 1900.

METEOROLOGICAL DATA.

Wind—South; velocity 12.
Temperature—58. 9°.
Atmosphere—Cloudy.

Total number of birds observed from 8:00 P. M. to 9:00 P. M.—4.

8:00 to 8:15—in 5.7—out 7.7.—Swift. Size 2.
in 3.2—out 8.9.—Swift. Size 1+. Total 2.
8:15 to 8:30—in 1.3—out 6.8.—Size 2. Out of focus; very close.
in 3.7—out 8.8.—Size 2. Same as preceding in good focus. Total 2.
8:30 to 8:45— Cloudy part of time. None.
8:45 to 9:00— Cloudy most of time None. Stopped observations on account of clouds.

MADISON, WIS., May 13, 1900.

METEROLOGICAL DATA.

Wind—South to South Southwest; velocity 14.
Temperature—74. 9°.
Atmosphere—Clear.

Total number of birds observed from 8:50 P. M. to 1:00 A. M.—96.

8:50 to 9:00—in 4.1—out 8.1—Size 1+.
in 3.9—out 8.3—Size 1—.
in 4.5—out 7.1—Swift—Indistinct.
in 4.1—out 8.1—Size 1—Somewhat blurred.
in 5.0—out 7.1—Size 1+.
in 3.0—out 1.9.
in 3.1—out 1.4—Swift—Like a shot.
in 4.5—out 6.8—Size 1+.
in 4.5—out 7.4—Indistinct—Total 9.
9:00 to 9:15—in 5.0—out 6.6—Size 3.
in 3.0—out 8.9—Size 2—Out of focus.
in 2.3—out 8.8—Size 2+. Out of focus.
in 2.8—out 8.8—Size 2+. Out of focus.

in 3.2—out 8.8—Size 2.
in 4.2—out 7.6—Size 1-|-.
in 4.0—out 7.3—Size 2-|-. Blurred.
in 3.2—out 8.3—Size 2-|-. Blurred.
in 4.1—out 7.4—Size 2-|-. Slightly blurred.
in 4.3—out 7.4—Size 3—Out of focus—Total 10.
9:15 to 9:30—in 4.5—out 8.0—Size 2—Slightly out of focus.
in 3.1—out 8.1—Size 1.
in 3.5—out 8.2—Size 2—Slightly out of focus.
in 4.0—out 8.2—Size 2.
in 4.0—out 7.5—Swift—Size 1—Like a shot.
in 3.5—out 8.4—Size 2.
in 4.1—out 8.6—Size 1—Indistinct—Total 7.
9:30 to 9:45—in 1.9—out 7.3—Size 2-|-. Indistinct.
in 2.6—out 1.4—Size 2.
in 4.9—out 6.8—Size 1-|-.
in 2.6—out 7.6—Size 2 — Somewhat out of focus.
in 4.0—out 8.1—Very fast—Size 1-|-. Somewhat out of focus.
in 3.8—out 8.4—Size 2—Blurred.
in 5.3—out 6.7—Blurred.
in 5.2—out 7.1—Size 2.
in 4.1—out 7.4—Size 1-|-. }
in 2.8—out 8.7—Size 1-|-. } Same species.
Total 10.
9:45 to 10:00—in 4.1—out 7.2—Size 1-|-.
in 2.7—out 1.0—Size 1-|-.
in 4.4—out 6.7—Size 1-|-.
in 2.8—out 8.9—Size 1—Total 4.
10:00 to 10:15—in 3.5—out 8.6—Size 3—Very distant.
in 8.5—out 8.0—Size 2-|-.
in 3.1—out 8.4—Size 2.
in 4.2—out 6.3—Size 2—Total 4.
10:15 to 10:30—in 1.7—out 8.8—Size 1-|-.
in 4.7—out 5.3—Size 1-|-.
in 3.1—out 7.1—Size 2-|-. Wing-strokes seen, somewhat blurred.
in 3.3—out 8.4—Size 2—Total 4.
10:30 to 10:45—in 4.2—out 8.3—Size 1.
in 2.4—out 8.3—Size 1-|-.
in 2.7—out 6.3—Size 2.

in 1.6—out 8.2—Size 2-|-. Very distinct.
in 4.2—out 8.3—Slow—Size 2—Wing-strokes slow.
in 3.1—out 7.2—Size 2 } Same species Total 7.
in 3.3—out 8.1—Size 2 }
10:45 to 11:00—in 3.4—out 7.4—Size 1-|-.
in 3.9—out 8.0—Size 2—Out of focus.
in 3.3—out 8.2—Curved below center.
in 2.2—out 7.1.
in 3.9—out 8.7—Size 1-|-. Wing-strokes plain. Total 5.
11:00 to 11:15—in 3.3—out 1.2—Size 1—Indistinct.
in 2.3—out 6.4—Size 2-|-. } Same species.
in 2.7—out 6.3—Size 2-|-. }
in 3.6—out 5.2—Size 2 } Same species.
in 2.6—out 6.4—Size 2 }
in 3.1—out 8.8—Size 1-|-. Indistinct.
in 4.0—out 8.3—Fast—Size 1.
in 2.8—out 7.2—Size 3.
in 2.4—out 7.1—Size 3.
in 1.1—out 7.8—Size 3—Curved around center.
in 3.7—out 6.8—Size 1-|-. Indistinct.
in 2.8—out 8.9—Size 1—Indistinct.
in 2.6—out 8.3—Swift—Size 1—Flew like a shot.
in 3.4—out 7.8—Swift—Size 2—Total 14.
11:15 to 11:30—in 1.5—out 7.2—Size 1-|-.
in 2.8—out 7.2—Size 2-|-.
in 3.2—out 8.9—Size 2.
in 4.8—out 7.7—Total 4.
11:30 to 11:45—in 0.0—out 0.0—Reversed telescope.
11:45 to 12:00—in 2.7—out 7.3—Size 2.
in 4.2—out 5.4—Size 2.
in 3.5—out 7.4—Size 1-|-. Indistinct.
in 4.4—out 6.5—Size 1-|-.
in 2.8—out 5.3—Size 1-|-.
in 8.9—out 6.7—Size 2—Indistinct—Total 6.
12:00 to 12:15—in 2.9—out 3.9—Size 2.
in 3.2—out 5.6—Size 2.
in 2.3—out 4.9—Size 2—Out of focus.
in 2.1—out 5.8—Size 3—Blurred, wind strong, southwest—Total 4.

12:15 to 12:30—in 2.2—out 6.3—Size 1.
in 2.1—out 7.2—Size 2.
in 2.0—out 6.0—Size 2.
in 2.5—out 5.2—Size 2—Total 4.
12:30 to 12:45—in 4.2—out 6.9—Size 2—Slightly blurred.
in 3.2—out 7.3—Size 1-|-. Total 2.
12:45 to 1:00—in 2.0—out 5.3—Size 2.
in 1.6—out 5.3—Size 2—Total 2.

MADISON, WIS., Oct. 8, 1900.

METEOROLOGICAL DATA.

Wind—Northwest to north northwest.
Temperature—47. 5°.
Atmosphere—Clear.
Total number of birds observed from 8:00 P. M. to 9:45 P. M.—35.

8:00 to 8:15—in 1.2—out 5.3—Size 2.
in 3.0—out 7.0—Size 3—Crow(?).
in 8.6—out 4.0.
in 7.8—out 5.0.
in 8.2—out 4.0.
in 8.5—out 3.0.
in 2.7—out 4.8.
in 7.0—out 3.2—Sailing with the wind—Total, 8.
8:15 to 8:30—in 8.8—out 3.0.
in 7.0—out 4.0.
in 7.8—out 4.3—Size 3-|-.—Long tail.
in 8.0—out 3.8—Out of focus.
in 7.2—out 4.0.
in 1.0—out 4.0.
in 7.0—out 3.0.
in 7.5—out 4.0.
in 1.5—out 2.7—Total 9.
8:30 to 8:45—in 0.0—out 0.0—No observations made.
8:45 to 9:00—in 8.0—out 3.6.
in 7.0—out 2.2.
in 6.2—out 1.8.
in 8.5—out 1.8.
in 7.0—out 3.3.
in 6.5—out 5.0.
in 6.5—out 4.5—Total 7.

9:00 to 9:15—in 8.2—out 2.6.
in 7.0—out 3.0.
in 7.5—out 3.0.
in 7.0—out 3.0.
in 1.0—out 5.0.
in 8.2—out 4.0—Total 6.
9:30 to 9:45—in 8.5—out 2.4.
in 7.5—out 4.0.
in 6.5—out 3.5.
in 6.5—out 2.7.
in 6.0—out 5.0—Total 5.

MADISON, WIS., Apr. 27, 1901.

METEOROLOGICAL DATA.

Wind—South.
Temperature—62. 8°.
Atmosphere—Clear.
Total number of birds observed from 9:45 P. M. to 11:00 P. M.—6.

9:45 to 10:00—in 0.0—out 0.0—Total 0.
10:00 to 10:15—in 3.8—out 6.7—Total 1.
10:15 to 10:30—in 0.0—out 0.0—Total 0.
10:30 to 10:45—in 0.0—out 0.0—Total 0.
10:45 to 11:00—in 2.3—out 5.7—Fast—Size 1.
in 2.7—out 6.0—Size 1+.
in 2.0—out 5.5—Fast—Size 1—Total 3.
11:00 to 11:15—in 1.9—out 6.2.
in 2.4—out 6.3—Size 3—Total 2.

MADISON, WIS., May 1, 1901.

METEOROLOGICAL DATA.

Wind—Southwest.
Temperature—72. 4°.
Atmosphere—Clear.
Total number of birds observed from 10:00 P. M. to 11:15 P. M.—3.

10:00 to 10:15—in 7.4—out 4.8—Total 1.
10:15 to 10:30—in 0.0—out 0.0—No observations made.
10:30 to 10:45—in 5.9—out 1.9—Out of focus—Total 1.
10:45 to 11:00—in 7.9—out 3.5—Total 1.
11:00 to 11:15—in 0.0—out 0.0—Total 0.

BELOIT, WIS., May 11, 1900.

METEOROLOGICAL DATA—(Taken same as for Madison).

Wind—South to southwest, velocity 10.
Temperature—69. 5°.
Atmosphere—Partly cloudy toward morning.
Total number of birds observed from 8:00 P. M. to 2:00 A. M.—134.

8:00 to 8:15—in 4.8—out 8.7.
in 2.5—out 8.0—Swift—Size 2—.
in 2.8—out 1.1—Size 1-|-.
in 3.0—out 7.6—Size 2.
in 5.2—out 7.1—Very Swift—Size 1—Total 6.
8:15 to 8:30—in 4.0—out 7.3—Very swift—Size 1.
in 4.8—out 5.5—Size 3-|-.—Out of focus.
in 4.0—out 5.8.
in 2.0—out 8.0 } Following each other closely.
in 2.0—out 8.0 }
in 3.0—out 7.5—Slow—Size 1.
in 3.0—out 7.0.
in 2.5—out 8.3.
in 5.0—out 5.7—Slow—Size 3—Seemed very close.
in 3.1—out 7.6—Slow—Size 2.
in 3.8—out 7.2—Size 1—Very distant.
in 1.0—out 5.5—Out of focus.
in 2.5—out 8.2—Size 2—Total 13.
8:30 to 8:45—in 2.0—out 8.0—Size 1—Total 1.
8:45 to 9:00—in 0.0—out 0.0—Total 0.
9:00 to 9:15—in 0.0—out 0.0—No observations made.
9:15 to 9:30—in 0.0—out 0.0—No observations made.
9:30 to 9:45—in 3.7—out 8.2—Size 2—Slightly out of focus.
in 4.2—out 6.8—Size 2—.
in 4.2—out 5.9—Size 3.
in 4.0—out 7.8—Very swift—Size 1—. Total 4.
9:45 to 10:00—in 2.2—out 7.6—Size 2.
in 4.2—out 7.6.
in 2.0—out 6.0—Size 3—Total 2.
10:00 to 10:15—in 3.9—out 6.6—Size 2.
in 8.3—out 5.2—Out of focus.
in 3.3—out 5.8—Swift—Size 2— } In field at
in 3.3—out 5.8—Swift—Size 2— } same time.
in 4.3—out 8.7—Swift—Size 2—. Total 5.

10:15 to 10:30—in 2.3—out 5.3—Swift—Size 1.
in 2.2—out 6.3—Swift—Size 1.
in 5.0—out 7.0—Swift—Size 1.
in 2.3—out 8.2—Wing-strokes visible, looked as if flying sidewise.
in 4.2—out 6.0.
in 8.9—out 7.0—Out of focus.
in 3.7—out 6.0—Size 1—. Very tiny, curved over center.
in 2.2—out 5.8—Very slow—Size 3—Total 8.
10:30 to 10:45—in 3.7—out 6.8—Size 1—Flight like goldfinch.
in 8.0—out 7.2—Size 3.
in 2.2—out 4.8—Swift—Size 1—. Very tiny—Total 3.
10:45 to 11:00—in 2.0—out 7.5—Swift—Size 2-|-.
in 2.2—out 5.3—Out of focus.
in 3.1—out 6.2—Size 2-|-. Wing-strokes visible.
in 2.2—out 6.9—Size 1.
in 2.5—out 5.8—Swift—Total 5.
11:00 to 11:15—in 1.2—out 8.2.
in 1.0—out 7.1—Size 2-|-. Curved.
in 2.7—out 7.2.
in 8.9—out 5.7—Very swift—Size 1—. Tiny.
in 2.2—out 6.8.
in 2.7—out 5.7—Swift—Size 2-|-. Total 6.
11:15 to 11:30—in 1.5—out 5.2—Slow—Out of focus.
in 2.1—out 6.8—Size 3—.Wing-strokes visible.
in 2.1—out 5.6—Size 2.
in 1.3—out 7.1—Total 4.
11:30 to 11:45—in 2.4—out 5.3.
in 3.0—out 6.4—Total 2.
11:45 to 12:00—in 2.2—out 8.5—Size 3-|-. Gull(?), large, slender wings and square tail.
in 3.2—out 4.8—Size 2.
in 1.8—out 5.2—Swift—Total 3.
12:00 to 12:15—in 2.7—out 4.3—Size 3.
in 1.7—out 6.0—Out of focus.
in 3.8—out 4.2—Size 3—Curved.
in 1.6—out 6.8—Size 2.
in 8.5—out 5.8—Out of focus—Total 5.
12:15 to 12:30—in 0.0—out 0.0—No observations made.
12:30 to 12:45—in 8.8—out 7.2—Slightly out of focus.
in 2.8—out 6.0—Same species as preceding.

in 8.2—out 6.3—Soaring—Out of focus—Total 3.
12:45 to 1:00—in 0.0—out 0.0—No observations made.
1:00 to 1:15—in 2.8—out 6.8—Swift—Size 2.
in 1.8—out 5.8 } 2 birds parallel to 1.8, 5.8 in
in 1.8—out 5.8 } field at same time.
in 2.8—out 5.8—Swift—Same as preceding—Out of focus.
in 2.3—out 5.4—Slow—Size 2.
in 3.0—out 5.2—Swift } Same species.
in 1.0—out 5.0—Swift }
in 1.0—out 5.8—Out of focus.
in 1.0—out 5.8.
in 1.3—out 2.8—Wing-strokes visible.
in 1.8—out 3.8.
in 1.0—out 7.2—Curved.
in 1.8—out 4.2—Flight like goldfinch.
in 2.8—out 6.0—Slow.
in 2.8—out 3.8—Slow—Total 15.
1:15 to 1:30—in 2.0—out 3.4—Swift.
in 1.0—out 7.2—Slow—Flight like goldfinch.
in 1.0—out 5.0—Size 2—Can hear many birds calling, as if circling overhead. Since 1:00 o'clock the birds seem to have been coming in bunches.
in 2.2—out 3.2—Curved.
in 3.2—out 7.2—Curved.
in 8.8—out 5.8—Slow—Flight like goldfinch.
in 2.8—out 4.0.
in 2.3—out 5.8—Slow.
in 1.3—out 6.3—Swift.
in 1.3—out 6.8—Swift.
in 2.3—out 0.0—Very swift.
in 8.7—out 6.6—Total 12.
1:30 to 1:45—in 8.6—out 5.8—Swift—Size 1+. } In field at
in 2.0—out 5.8—Swift—Size 1+. } same time.
in 2.0—out 5.8—Swift—Size 1+. }
in 1.0—out 7.0—Size 1+. } Succeeding each
in 1.8—out 5.5—Size 1+. } other very rap-
in 5.8—out 6.1—Size 1+. } idly.
in 1.0—out 6.0—Out of focus.
in 2.8—out 5.0—Swift—Size 1—.

in 2.8—out 4.6—Slow—Curved.
in 1.0—out 5.8—Swift—Size 1—.
in 8.3—out 7.0—Swift—Size 2—.
in 2.0—out 4.6—Flight like goldfinch.
in 2.0—out 5.8—Same as preceding one.
in 6.0—out 7.8.
in 8.7—out 6.8.
in 1.5—out 5.2—Size 1—. Very tiny.
in 1.1—out 5.5.
in 8.3—out 6.7—Out of focus.
in 1.6—out 5.8—Out of focus.
in 1.6—out 6.6—Out of focus.
in 1.0—out 5.2—Slow—Total 21.
1:45 to 2:00—in 8.4—out 7.8.
in 1.8—out 0.0 }
in 1.0—out 5.6 } Same species.
in 2.8—out 4.6.
in 2.0—out 4.6.
in 2.7—out 4.0—Swift.
in 3.5—out 2.0.
in 8.2—out 6.9—Size 2.
in 1.0—out 5.3.
in 8.3—out 6.0—Swift—Size 1-|-.
in 2.8—out 4.3.
in 5.0—out 8.0—Slow—Size 3.
in 1.8—out 5.2.
in 2.2—out 4.8 } Swift—Succeeding each other
in ...—out ... } closely.
in ...—out ... } In field at same time.
Clouds at 1:45 obscured the moon; moon low in southwest—Total 16.

BELOIT, WIS., May 12, 1900.

METEOROLOGICAL DATA.

Wind—Southwest, velocity 12.
Temperature—70. 8°.
Atmosphere—Clear.

Total number of birds observed from 8:00 P. M. to 3:25 A. M.—363.

8:00 to 8:15—in 3.1—out 8.5.
in 3.7—out 7.9.

in 2.5—out 8.5.
in 4.5—out 6.4—Swift.
in 3.0—out 7.6—Slow.
in 3.2—out 7.5.
in 3.5—out 8.1—Distant.
in 4.5—out 5.6—Size 3—Out of focus.
in 4.5—out 6.8—Size 3—Total 9.
8:15 to 8:30—in 0.0—out 0.0—No observations made.
8:30 to 8:45—in 3.8—out 6.6—Swift—Size 2—.
in 3.0—out 6.1—Size 2-|-. Out of focus.
in 3.0—out 6.0—Size 2-|-. Out of focus.
in 3.8—out 7.7—Size 1—Flight like goldfinch.
in 3.8—out 1.2—Slow—Distant—Total 5.
8:45 to 9:00—in 4.0—out 6.5—Slow—Distant.
in 3.8—out 6.4—Swift—Out of focus.
in 3.0—out 8.6—Slow.
in 3.2—out 7.5—Very fast—Size 1.
in 3.2—out 8.8—Slow—Size 3—Total 5.
9:00 to 9:15—in 3.2—out 8.1—Slow—Size 3—Large wings.
in 2.8—out 8.3.
in 3.0—out 7.2—Size 1—Very small.
in 3.2—out 7.8—Swift—Size 1—Out of focus.
in 3.8—out 8.8—Curved up.
in 3.2—out 7.5—Size 2—Total 6.
9:15 to 9:30—in 3.5—out 6.3—Swift—Size 2 } Same species.
in 3.2—out 6.0—Swift—Size 2 }
in 3.8—out 6.2—Size 2-|-.
in 3.2—out 7.2—Swift—Size 1—.
in 3.7—out 6.2—Very distant.
in 2.4—out 1.6—Total 6.
9:30 to 9:45—in 3.3—out 5.7.
in 3.0—out 7.0.
in 3.4—out 7.6—Total 3.
9:45 to 10:00—in 0.0—out 0.0—No birds for 2 or 3 minutes.
in 3.0—out 5.0—Swift—Size 1—.
in 8.9—out 6.8—Swift—Size 3.
in 1.0—out 6.0—Size 1—. } Same species in
in 1.2—out 6.0—Size 1—. } field at same time.
in 7.0—out 3.0—Curved around center.
in 1.7—out 4.2—Out of focus.
in 1.6—out 4.0 } Same Species.
in 8.9—out 6.0 }
in 1.0—out 4.5—Out of focus.

in 8.0—out 5.2—Out of focus.
in 2.0—out 5.0—Size 1+. The only bird in the last five minutes—Total 11.
10:00 to 10:15—in 8.9—out 5.7.
in 8.0—out 7.0—Slow—Size 1.
in 1.0—out 5.0—Size 1.
in 1.0—out 5.0 }
Pause. } No birds for about 1 minute. Same species—Out of focus.
in 1.0—out 5.0 }
in 1.0—out 5.0.
in 7.0—out 5.0—Out of focus.
in 7.5—out 4.0.
in 1.0—out 4.7—Slow—Size 3.
in 0.0—out 0.0—Short pause of no birds.
in 2.0—out 3.6 }
in 1.3—out 2.4 } Out of focus—Total 12.
in 1.0—out 3.0 }
10:15 to 10:45—in 0.0—out 0.0—No observations taken.
10:45 to 11:00—in 3.0—out 7.0—Size 3.
in 3.5—out 6.0—Size 3—Same as preceding.
in 3.0—out 4.8—Swift—Size 2—A snipe is calling.
in 1.7—out 6.3—Swift—Size 2.
in 1.5—out 8.5.
in 3.7—out 6.4—Swift—Size 2—Curved.
in 8.2—out 7.1—Size 3.
in 2.0—out 8.0.
in 3.0—out 6.2—Swift—Size 1.
in 2.0—out 8.0.
in 1.5—out 5.9—Out of focus, curved—Total 11.
11:00 to 11:15—in 3.0—out 5.7—Size 2.
in 1.6—out 5.6—Swift—Size 2—.
in 1.0—out 7.8.
in 1.8—out 6.7—Size 2—Total 4.
11:15 to 11:30—in 4.8—out 5.5.
in 8.6—out 5.8.
in 1.0—out 7.0—Size 2+. }
in 2.0—out 6.0—Size 2+. } Same species.
in 2.0—out 8.2—Curved across edge of field.
in 3.8—out 6.2.
in 2.0—out 7.0—Curved through center.

in 2.0—out 6.0—Swift—Size 1—Out of focus.
in 2.0—out 8.0—Size 2.
in 8.2—out 7.0—Swift—Size 2—.
in 2.2—out 6.1—Slow—Size 3—Looked like a gallinaceous bird—Total 11.
11:30 to 11:45—in 0.0—out 0.0—No observations taken.
11:45 to 12:00—in 1.7—out 8.2—Slow—Size 3—Distant, wing-strokes plain.
in 1.0—out 5.2—Slow—Size 3—Wing-strokes plain.
in 2.0—out 8.0.
in 8.5—out 7.0.
in 2.0—out 6.0—Size 3—Wind turning southeast. Total 5.
12:00 to 12:15—in 2.0—out 6.0—Swift—Size 1.
in 2.0—out 6.0—Swift—Size 1.
in 1.8—out 5.0—Swift—Size 1.
in 1.8—out 5.0—Swift—Size 1.
Across the field in almost the same time. Same species.
in 1.8—out 6.3.
in 2.2—out 5.8.
in 2.2—out 4.9—Total 7.
12:15 to 12:30—in 3.2—out 4.2.
in 1.0—out 5.5—Swift—Size 2.
in 2.5—out 4.0—Out of focus—5 minutes used to reverse telescope; snipe calling—Total 3.
12:30 to 12:45—in 2.0—out 4.7.
in 4.0—out 5.8—Slow—Distant.
in 1.7—out 5.8.
in 2.0—out 8.0—Size 1—. Curved.
in 2.7—out 5.8.
in 1.5—out 6.4.
in 2.2—out 4.9.
in 1.6—out 5.8—Swift—Size 1-|-.
in 3.0—out 5.1—Total 9.
12:45 to 1:00—in 8.5—out 6.5.
in 4.0—out 2.0—Out of focus.
in 1.0—out 3.0—Out of focus, curved.
in 2.0—out 6.8.
in 1.8—out 4.8—Swift.
in 2.6—out 5.3.
in 8.5—out 5.8.

in 8.2—out 6.3.
in 2.3—out 5.7.
in 1.8—out 5.0.
in 8.9—out 6.2—Total 11.
1:00 to 1:30—in 0.0—out 0.0—No observations taken.
1:30 to 1:45—in 2.0—out 4.9—Slow—Flight like goldfinch.
in 2.2—out 4.9.
in 1.8—out 4.9.
in 4.8—out 6.2 }
in 4.8—out 6.2 } 2 parallel to 4.8, 6.2.
in 1.0—out 5.0.
in 8.7—out 5.8—Swift.
in 2.2—out 5.7.—Size 2—.
in 3.7—out 5.0.—Swift. Size 2—.
in 1.8—out 5.5.—Swift. Size 2—.
in 1.8—out 4.5.—Swift. Size 2—.
— —
— —
in 2.3—out 4.3.—Same birds rapidly succeed-
in 8.5—out 6.4. ing each other. Total 15.
1:45 to 2:00—in 2.3—out 4.4.—Swift. Size 1.
in 1.6—out 4.9.—Swift. Size 2.
in 1.3—out 4.8.—Swift. Size 2.
in 1.3—out 4.7.—Same birds rapidly succeed-
in 1.0—out 5.6. ing each other.
in 8.0—out 5.7.
in 8.9—out 6.0.
in 2.3—out 5.4.
in 2.8—out 4.8.
in 2.0—out 5.8.—Swift.
in 2.0—out 5.5.—Size 2+.
in 1.9—out 5.6.
in 1.5—out 5.6.—This and 2 preceding are same species.
in 1.8—out 4.8.
in 8.8—out 5.8.
in 8.8—out 5.5.—Size 1+.
— —
— —
— —
— — Same birds all flying about
— — parallel to 8.8—5.5. They
— — seem to be coming in

— — bunches, several in the field
— — at same time. Came too
— — fast to note exact direction.
in 1.8—out 5.8.—Size 2—.
in 2.0—out 5.8.
in 3.0—out 8.3.—Size 1—.
in 1.2—out 6.3.—Size 2—.
in 2.1—out 4.3.—Slow. Size 2.
in 1.2—out 6.0.—Size 1.
in 1.8—out 5.8.—Size 2.
in 3.0—out 6.3.—Swift.
in 2.8—out 5.8.—Size 2.
in 1.6—out 5.8.—Size 2. Total 35.
2:00 to 2:15—in 1.7—out 5.8.—Swift. Size 1.
in 2.0—out 7.0.—Size 2. Seen edgewise.
in 8.2—out 5.9.—This and preceding in field at
in 2.0—out 5.0. same time.
in 2.0—out 5.0.
in 1.0—out 6.0.
in 8.8—out 6.0.
in 1.5—out 5.2.
in 1.2—out 6.4.—Succeeding eachother rapidly.
in 3.0—out 4.4.
in 4.2—out 6.2.—Probably all same species.
in 1.0—out 6.0.—Looked like Icteridae.
in 2.0—out 3.7.
— —
— —
— —
in 8.6—out 5.9.
in 1.7—out 4.9.—Size 2.
in 3.0—out 4.5.
in 1.2—out 5.5.—Size 2.
in 1.8—out 5.7.
in 2.2—out 5.7.—Total 22.
2:15 to 2:30—in 1.2—out 5.2.
in 1.3—out 5.0.—This and preceding same species.
in 8.9—out 5.8.
in 1.5—out 5.0.
in 1.3—out 5.5.
in 8.6—out 5.8.
in 1.5—out 5.6.—Size 1—.

in 8.5—out 6.2.—Flight like goldfinch.
in 1.0—out 5.2.—Swift. Size 1—.
in 2.3—out 5.0.
in 2.5—out 5.0.
in 1.2—out 5.8.—No birds seen for last five minutes. Total 12.
2:30 to 2:45—in 1.8—out 4.6.
in 2.0—out 5.6.—Size 1.
in 1.5—out 5.0—Size 1. Many lisps are heard.
in 2.0—out 5.8.
in 2.5—out 5.2.—Size 1.
in 2.5—out 5.2.—Size 1. This and preceding parallel to 2.5—5.2. In field at same time.
in 2.0—out 5.8.—Slow. Size 1+.
— — Flock. About 10 all parallel to about 2.0—5.8.
in 8.3—out 6.0.—Three more.
in 2.0—out 4.6.—Many parallel to 2.0—4.6.
in 1.2—out 5.5.
in 3.0—out 4.4.—Slightly larger than preceding.
in 1.8—out 5.0.
in 1.0—out 5.6.—About 11 parallel to 1.0—5.6.
in 2.0—out 5.2.
in 2.0—out 5.2.
in 2.0—out 5.2.—Fast. Size 1. This and two preceding.
in 2.0—out 5.2.
in 2.2—out 5.0.
in 2.2—out 5.0.
in 2.0—out 5.0.
in 2.0—out 5.0.
in 2.0—out 5.0.—Note regularity of direction.
in 2.5—out 4.3.
in 2.0—out 5.6.
in 2.2—out 5.2.
in 2.0—out 5.0.
in 1.2—out 5.5.
in 6.2—out 6.4.
in 6.2—out 6.4.
in 2.0—out 4.8.
in 2.0—out 5.0.—Total 53.

2:45 to 3.00—in 2.2—out 4.7.—3 parallel to 2.2—4.7.
in 1.5—out 5.0.—Same species.
in 2.1—out 5.0.
in 8.9—out 6.0.
in 1.0—out 6.0.
in 1.5—out 5.2.—3 parallel to 1.5—5.2.
— — Another and another.
in 1.0—out 5.8.—4 parallel to 1.0—5.8.
— — Same species.
— — 2 more.
— — Another.
in 1.5—out 5.3.—5 parallel to 1.5—5.3. All these had flight like goldfinch and were probably same species.
in 2.0—out 4.5.
in 2.0—out 4.3.—Many lisps are heard.
in 2.5—out 5.3.
in 3.0—out 4.4.
— — Same as preceding; out of focus.
in 2.5—out 5.2.—2 parallel to 2.5—5.2.
— — Pause. No birds for over one minute.
in 2.0—out 5.0.—Flight like goldfinch.
in 1.5—out 5.4.
in 1.5—out 5.4.
in 2.0—out 4.7.
in 2.0—out 4.7.—Coming in regular succession.
in 2.0—out 5.0.
in 2.0—out 5.0.—Out of focus.
— — 2 more not out of focus.
— — Another.
in 8.5—out 6.0.
in 1.0—out 5.7.
in 1.5—out 5.0.
in 1.5—out 5.5.—Slightly larger than the preceding ones.
in 1.0—out 5.6.
in 1.8—out 5.2.
in 1.8—out 5.2.—This and preceding rapidly succeeding each other. Total 48.

3:00 to 3:15—in 1.9—out 5.3.
in 2.0—out 4.8.
in 2.0—out 5.0.—2 birds; flight like goldfinch.
in 1.5—out 5.2.—Same; 3 birds.
in 2.0—out 5.2.—Out of focus.
in 2.0—out 5.5.—Flew toward me. In field a long time.
in 5.0—out 5.8.
in 5.0—out 5.8.—Same as preceding.
— — Out of focus.
in 1.0—out 6.2.—Out of focus.
in 2.0—out 5.0.—2 birds, flight like goldfinch.
in 1.2—out 6.0.
in 2.2—out 4.9.—2 birds.
in 8.3—out 5.8.
in 1.0—out 5.9.—Very slow.
in 1.0—out 5.9.—4 birds; flight like goldfinch.
in 2.0—out 6.0.—2 birds; flight like goldfinch.
in 8.9—out 6.2.
in 1.0—out 5.0.—Out of focus.
in 1.8—out 5.0.
in 2.0—out 4.7.
in 3.2—out 6.8.—Flew toward me. It grew in size.
in 2.0—out 5.0.
in 8.7—out 6.0.
in 8.5—out 6.0.—Out of focus.
in 1.2—out 5.0.
in 1.8—out 5.2.
in 2.0—out 5.0.—2 birds.
in 5.8—out 1.5.—Size 1. Away out of focus.
in 2.0—out 5.0.—12 more at almost the same time.
— — 2 more, same direction and 2 farther off.
in 8.3—out 5.2.
— — Several were succeeding each other rapidly. Total 56+.
3:15 to 3:30—in 1.8—out 5.0.
in 2.5—out 3.7.
in 1.0—out 5.8.
— — Pause. Moon obscured by clouds.

in 1.5—out 6.0.
in 1.0—out 5.3.—Size 3.
Total 5. Stopped at 3:25. Moon low in S. W., dropping behind a bank of clouds.

BELOIT, WIS., May 13, 1900.

METEOROLOGICAL DATA.

Wind—South to southwest, velocity 12.
Temperature—74. 9°.
Atmosphere—Clear.
Total number of birds observed from 8:00 P. M. to 3:45 A. M.—285.

8:00 to 8:15—in 3.0—out 7.4—Slow—Size 2. Long tail.
in 4.0—out 6.7—Size 2—.
in 8.0—out 2.2—Size 1. Out of focus.
in 3.3—out 7.7.
in 3.2—out 7.1—Size 2—. Flight like goldfinch.
in 5.0—out 8.1—Size 1—. Total 6.
8:15 to 8:30—in 3.2—out 7.0—Size 2—.
in 2.9—out 7.2—Size 2+.
in 2.8—out 7.2—Size 1—.
in 4.0—out 6.8—Size 2—.
in 8.0—out 2.0—Size 1. Out of focus.
in 2.8—out 7.6—Size 2—.
in 3.8—out 6.7—Size 2+.
in 3.0—out 7.5—Size 1—.
in 3.5—out 7.4—Size 2.
in 3.8—out 7.7—Size 2.
in 2.2—out 8.2—Slow—Size 2+.
in 3.7—out 7.0—Swift.
in 2.2—out 8.2—Size 2+. Slightly out of focus.
in 8.2—out 3.0—Size 1—Out of focus. Total 14.
8:30 to 8:45—in 3.5—out 7.0.
in 2.0—out 8.5.
in ...—out ...—Missed direction.
in 2.7—out 7.2—Swift—Size 2.
in 3.7—out 6.6—Swift—Size 2+.

in 3.7—out 7.0.
in 1.2—out 6.3—Size 2—Out of focus.
in 3.8—out 7.5—Size 1-|-. Total 8.
8:45 to 9:00—in 3.2—out 7.2—Slow—Size 3.
in 3.2—out 7.2—Swift—Size 1.
in 3.8—out 6.6—Size 2-|-.
in 3.7—out 7.2—Swift.
in 4.6—out 6.3—Total 5.
9:00 to 9:15—in 2.8—out 7.0.
in 3.2—out 7.5—Swift—Size 1.
in 3.7—out 6.3—Size 2-|-.
in 4.9—out 6.7.
in 1.7—out 7.2—Swift.
in 3.8—out 6.8—Size 2.
in 2.1—out 7.5.
in 2.8—out 7.8.
in 2.6—out 8.4—Total 9.
9:15 to 10:00—in 0.0—out 0.0—No observations taken.
10:00 to 10:15—in 3.8—out 6.9—Close, wing-strokes plain.
in 2.3—out 7.2.
in 3.7—out 6.7.
in 3.2—out 6.7—Very swift—Size 2—Looked tiny.
in 3.5—out 7.2—Very swift—Size 2—Looked tiny.
in 3.6—out 7.2.
in 4.0—out 6.2—Out of focus.
in 3.0—out 7.2.
in 3.0—out 7.0—Total 9.
10:15 to 10:30—in 2.3—out 7.3.
in 5.4—out 7.3.
in 2.4—out 8.3.
in 4.0—out 7.0.
in 3.0—out 1.8.
in 3.0—out 7.3—Total 6.
10:30 to 10:45—in 3.0—out 7.6.
in 1.4—out 7.5—Out of focus.
in 1.8—out 4.8.
in 3.6—out 6.3.
in 2.8—out 8.2.
in 4.0—out 6.2.
in 4.0—out 7.1—Total 7.

10:45 to 11:00—in 2.8—out 4.8—Slow—Size 2+.
in 3.0—out 7.2.
in 2.4—out 7.5.
in 3.5—out 6.3.
in 1.5—out 5.2.
in 8.6—out 7.1—Size 3.
in 3.7—out 6.2.
in 1.3—out 8.5—Swift—Killdeer calling.
in 2.5—out 7.3—This was the only bird during the last 5 minutes. Total 9.
11:00 to 11:15—in 4.0—out 6.0—Swift—Out of focus. Total 1.
11:15 to 11:30—in 3.0—out 8.1.
in 3.8—out 2.4—Size 1—. Curved near center.
in 3.2—out 5.3.
in 1.2—out 7.2.
in 2.4—out 8.0—Total 5.
11:30 to 11:45—in 4.2—out 8.1—Size 1—.
in 2.0—out 8.0—Size 3.
in 4.6—out 6.2—Size 3—.
in 3.0—out 4.3—Size 3—Close.
in 5.2—out 6.8—Curved.
in 4.0—out 5.3.
in 3.0—out 5.0—Swift—Size 3. Total 7.
11:45 to 12:00—in 4.0—out 6.0—Total 1.
12:00 to 12:30—in 0.0—out 0.0—No observations taken.
12:30 to 12:45—in 2.8—out 6.0—Strong S. W. wind arising.
in 3.7—out 6.1—Swift—Size 2—
in 1.0—out 7.8—Swift—Size 2— Same species.
in 2.0—out 6.6—Swift—Size 2—
in 2.6—out 5.0—Swift—Size 2—
in 2.2—out 5.9—2 birds, out of focus.
in 8.3—out 7.6—Same as preceding.
in 1.8—out 5.8—Total 8.
12:45 to 1:00—in 2.0—out 7.1—Slightly out of focus.
in 1.0—out 5.5—Very distant.
in 3.9—out 5.8.
in 3.5—out 7.2.
in 2.0—out 5.1—Size 2.
in 8.8—out 6.4—Out of focus.
in 1.3—out 5.3—Total 7.
1:00 to 1:15—in 2.0—out 5.7—Size 2+. 2 birds.
in 5.0—out 7.2—Slightly out of focus.

in 1.3—out 5.8—Swift
in 2.8—out 5.2—Swift } Same species.
in 2.8—out 5.2—Swift
in 8.6—out 7.8—Out of focus.
in 2.5—out 5.7—Curved below center, circling the edge of the field.
in 2.7—out 5.7—Curved over center. Total 9.
1:15 to 1:30—in 0.0—out 0.0—No observations taken.
1:30 to 1:45—in 4.2—out 1.2.
in 1.0—out 5.8—Slightly out of focus.
in 2.4—out 6.8—Distant.
in 8.3—out 6.8.
in 3.0—out 5.9—Out of focus.
in 8.2—out 6.0—Out of focus.
in 2.0—out 6.0—Close and large. This bird made a complete turn in the field.
in 1.0—out 5.8—Total 8.
1:45 to 2:00—in 1.0—out 6.8.
in 2.3—out 5.8—2 birds, both curved over center.
in 8.4—out 7.1—Out of focus.
in 8.6—out 7.0.
in 3.0—out 4.9.
in 1.0—out 6.5—Out of focus, curved.
in 3.7—out 5.7.
in 1.7—out 5.3—Out of focus. Total 9.
2:00 to 2:15—in 0.0—out 0.0—No observations taken.
2:15 to 2:30—in 7.0—out 6.0—Out of focus.
in 3.5—out 4.2.
in 2.3—out 5.6—Size 3—2 birds.
in 4.8—out 7.9—Size 1—.
in 2.2—out 5.8—Slow—Wing-strokes plain.
in 2.0—out 5.2—Swift.
in 2.1—out 4.0—Looked as if propelled by wind.
in 5.5—out 1.7—Out of focus—Total 9.
2:30 to 2:45—in 2.0—out 6.0.
in 8.6—out 7.2.
in 2.0—out 5.2.
in 1.0—out 5.2.
in 1.8—out 5.5—Swift.
in 1.8—out 5.2—Out of focus.

in 2.3—out 5.0.
in 1.8—out 5.6—Size 2.
in 1.0—out 7.6.
in 2.6—out 8.2—Very distant.
in 1.6—out 5.7—Total 12.
in 8.5—out 5.9—Out of focus.
2:45 to 3:00—in 0.0—out 0.0—No observations taken.
3:00 to 3:15—in 2.6—out 5.0.
in 2.0—out 4.5.
in 1.6—out 5.5.
in 2.0—out 4.7.
in 8.6—out 5.8—2 birds.
in 1.0—out 7.2—Out of focus.
in 5.2—out 1.5.
in 1.0—out 6.3—Over center.
in 1.5—out 5.3—Flight and call like goldfinch.
in 8.4—out 6.3—Same as preceding.
in 5.3—out 8.7—Out of focus.
in 2.3—out 4.4—Slow.
in 1.8—out 5.6—4 birds.
in 2.0—out 5.6—Size 3.
in 1.2—out 5.7.
in 3.1—out 4.1—Slow.
in 1.6—out 5.0—Swift—Size 1.
in 2.0—out 4.8—Total 22.
3:15 to 3:30—in 8.7—out 6.0—2 birds.
in 8.1—out 6.1—Out of focus.
in 6.0—out 1.0—Out of focus.
in 2.1—out 5.5.
in 3.0—out 4.6—2 birds.
in 2.0—out 5.8—Flight like goldfinch.
in 2.2—out 5.5.
in 2.0—out 6.0—2 birds.
Another.
in 2.0—out 6.0—About a dozen parallel to 2—6
in 2.0—out 6.0—6 more.
in 6.0—out 8.2—Out of focus.
in 2.0—out 5.0—Several parallel to 2—5.
in 3.7—out 2.5—Out of focus. Little groups of birds are succeeding each other in ever-increasing rapidity. Total 33.

3:30 to 3:45—in ...—out ...—Total 81.

The birds were flying in such rapid succession that I could not stop to take the direction. There were 81 birds counted, flying from about 2—5 and 2—6. Of these about 15 were out of focus and flying in promiscuous directions. The moon was being obscured by the trees. The telescope made an angle of about 8° with the horizontal.

LAKE FOREST, Ill., May 11, 1900.

METEOROLOGICAL DATA.

Wind—Moderate; Southwest.
Temperature—Warm.
Atmosphere—Partly cloudy.

Total number of birds observed from 7:45 P. M. to 10:55 P. M.—73.

7:45 to 8:00—in 4.0—out 2.0.—Fast. Size 2.
in 4.0—out 2.0.—Fast. Size 2.
in 4.0—out 2.0.—Fast. Size 2.
in 4.0—out 2.0.—Fast. Size 2. This and all preceding out of focus.
in 4.0—out 2.0.—Fast. Size 2. Wing-strokes seen.
in 4.0—out 2.0.—Fast. Size 2.—Out of focus. Total 6.

8:00 to 8:15—in 4.0—out 2.0.—Fast. Size 2.
in 3.0—out 2.0.—Fast. Size 2.
in 3.0—out 2.0.—Fast. Size 2.
in 4.0—out 1.0.—Fast. Size 2. This and all preceding out of focus. Total 4.

8:15 to 8:45 No observations taken.

8:45 to 9:00—in 4.0—out 2.0.—Fast. Size 1. Flight like a shot. Total 1.

9:00 to 9:15—in 3.0—out 2.0.—Fast. Size 2. Out of focus. Total 1.

9:15 to 9:30—in 3.0—out 1.0.—Fast. Size 2.
in 4.0—out 1.0.—Rather slow. Size 2. Wing-strokes seen.
in 4.0—out 2.0.—Fast. Size 2.
in 2.7—out 4.2.—Slow. Size 3. Wing-strokes seen. Total 4.

9:30 to 9:45—in 4.0—out 2.0—Fast. Size 1.
in 3.0—out 1.0.—Slow. Size 2+.

in 2.0—out 1.0.—Medium slow. Size 3.
in 3.0—out 1.0.—Fast. Size 2-|-. Wing-strokes seen.
in 2.0—out 4.0.—Fast. Size 2-|-. Total 5.
9:45 to 10:00—in 3.0—out 1.0.—Fast. Size 1.
in 4.2—out 4.8.—Fast. Size 2.
in 1.1—out 2.1.—Slow. Size 1.
in 3.6—out 2.2.—Slow. Size 1. This and all preceding out of focus. Total 4.
10:00 to 10:15—in 3.5—out 1.5.—Fast. Size 1.
in 3.5—out 2.5.—Fast Size 1.
in 4.3—out 2.6.—Fast. Size 1.
in 4.3—out 2.6.—Fast. Size 1.
in 2.9—out 2.2.—Fast. Size 1.
in 3.5—out 2.5.—Fast. Size 1.
in 3.0—out 4.1.—Fast. Size 1.
in 3.0—out 1.0.—Fast. Size 1.
in 3.0—out 1.0.—Fast. Size 1.
in 4.1—out 1.0.—Fast. Size 1.
in 3.0—out 2.1.—Fast. Size 1.
in 3.5—out 4.7.—Fast. Size 1.
in 3.5—out 1.5.—Fast. Size 1.
in 3.7—out 1.7.—Fast. Size 1.
in 3.0—out 1.0.—Fast. Size 1. This and all preceding out of focus. Total 15.
10:15 to 10:30—in 4.0—out 4.5.—Fast. Size 1. Out of focus.
in 3.9—out 1.1.—Size 1. Out of focus.
in 3.7—out 1.3.—Size 2. Wing-strokes seen.
in 3.2—out 1.9.—Size 1. Out of focus.
in 3.7—out 1.9.—Size 1. Out of focus.
in 3.0—out 1.2.—Fast. Size 2.
in 3.5—out 2.7.—Fast. Size 1. Wing-strokes seen.
in 3.7—out 1.9.—Medium. Wing-strokes seen.
in 2.9—out 1.2.—Fast. Size 2. Out of focus.
in 3.7—out 1.5.—Fast. Size 1.
in 2.1—out 1.1.—Fast. Size 2.
in 2.1—out 4.5.—Fast. Size 2. Out of focus. Total 12.
10:30 to 10:45—in 2.2—out 4.9—Fast. Size 2. Wing-strokes seen.

in 4.6—out 3.1.—Slow. Size 2. Wing-strokes seen.
in 4.4—out —.Slow. Size 1. Out of focus.
in 3.0—out —.Slow. Size 1. Out of focus.
in 2.5—out 4.5.—Very fast. Size 1. Out of focus.
in 2.2—out 4.8.—Fast. Size 1. Out of focus.
in 2.7—out 4.1.—Fast. Size 2-|-.
in 2.9—out 4.3.—Fast. Size 2-|-. Total 8.
10:45 to 11:00—in 2.6—out 1.3.—Fast. Size 1. Out of focus.
in 3.5—out 1.3.—Fast. Size 2. Wing-strokes. seen.
in 3.1—out 3.9—Fast. Size 2. Out of focus.
in 2.2—out 4.3.—Fast. Size 2-|-.
in 1.9—out 4.8.—Fast. Size 2-|-.
in 2.7—out 4.8.—Fast. Size 2. Out of focus.
in 3.5—out 1.3.—Fast. 2-|-.
in 2.2—out 4.7.—Fast. Size 2. Out of focus.
in 1.9—out 4.8.—Fast. Size 2.
in 3.9—out 1.3.—Fast. Size 1-|-. Out of focus.
in 2.5—out 4.5.—Fast. Size 2. Out of focus.
in 2.2—out 4.1.—Fast. Size 2. Wing-strokes seen.
in 2.3—out 1.2.—Fast. Size 2. Total 13.

LAKE FOREST, Ill., May 14, 1900.

METEOROLOGICAL DATA.

Wind—Moderate Southwest.
Temperature—Warm.
Atmosphere—Partly cloudy; showed at midnight.

Total number of birds observed from 9:30 P. M. to 10.55 P. M.—61.

9:30 to 10:00—in 3.6—out 2.9.—Fast. Size 2. Wing-strokes seen.
in 4.6—out 3.6.—Fast. Size 2. Out of focus.
in 3.3—out 4.4.—Fast. Size 2. Out of focus.
in 3.9—out 2.1.—Fast. Size 2-|-. Wing-strokes seen.
in 3.9—out 2.8.—Size 1. Out of focus; like a shot.
in 4.6—out 2.7.—Fast. Size 1-|-.
in 4.9—out 1.7.—Fast. Size 2.

in 3.8—out 2.7.—Fast. Size 3. Crow(?). Wing-strokes plain.
in 4.3—out 2.6.—Fast. 2-|-.
in 4.9—out 1.9.—Fast. Size 2-|-.
in 4.5—out 1.7.—Fast. Size 2.
in 4.3—out 2.4.—Fast. Size 2.
in 4.3—out 2.6.—Fast. Size 2-|-.
in 2.9—out —.—Fast. Size 1-|-.
in 3.8—out 1.2.—Fast. Size 2-|-.
in 4.2—out 3.3.—Fast. Size 2. All the above in good focus.
in 3.2—out 1.6.—Fast. 2-|-. Out of focus. Total 17.
10:00 to 10:30—in 3.2—out 2.9.—Medium. Size 2. Out of focus.
in 3.7—out 4.7.—Fast. Size 2-|-.
in 3.3—out 2.6.—Fast. Size 2-|-. Out of focus.
in 3.5—out 1.4.—Fast. Size 2.
in 2.6—out 4.4.—Fast. 3—.
in 2.5—out 4.5.—Slow. Size 3. Crow(?).
in 2.5—out 1.9.—Fast. Out of focus.
in 3.5—out 2.5.—Fast. Size 2. Out of focus.
in 2.5—out 2.0.—Fast. Size 2. Out of focus.
in 1.5—out 3.5.—Fast. Size 3—. Wing-strokes plain.
in 2.9—out 2.2.—Fast. Size 1. Out of focus.
in 4.7—out 1.4.—Fast. Size 1.
in 3.8—out 2.5.—Slow. Size 3.—Crow (?) Wing-strokes plain.
in 2.9—out 2.3.—Fast. Size 2—.
in 4.6—out 2.4.—Size 1. Like a shot.
in 3.8—out 2.8.—Slow. Size 3. Crow (?). Wing-strokes plain.
in 3.9—out 2.6.—Slow. Size 2. Wing-strokes plain.
in 4.4—out 2.6.—Fast. Size 2—. Wing-strokes dimly seen.
in 1.1—out 1.9.—Fast. Size 1-|-.
in 3.9—out 2.6.—Size 2.
in 3.4—out 2.8.—Slow. Size 3. Wing-strokes seen.
in 3.8—out 2.8.—Fast. Size 2-|-. Wing-strokes seen.

in 4.8—out 1.4.—Size 2.
in 4.6—out 2.6.—Size 1-|-.
in 3.7—out 2.6.—Size 2.
in 4.1—out 1.4.—Size 3. Total 26.
10:30 to 10:55—in 3.7—out 2.2.—Medium. Size 3.
in 4.7—out 2.4.—Fast. Size 1-|-.
in 3.9—out 1.4.—Medium. Size 2-|-. Appeared to be near.
in 4.7—out 2.3.—Slow. Size 2. Appeared far off.
in 4.3—out 3.1.—Fast. Size 2. Out of focus.
in 3.6—out 2.6.—Slow. Size 2-|-. Dimly seen.
in 4.1—out 1.5.—Fast. Size 2-|-.
in 3.9—out 4.6.—Fast. Size 2-|-.
in 4.5—out 2.5. Size 1-|-. Like a shot.
in 3.3—out 1.5.—Slow. Size 2-|-.
in 4.3—out 2.5.—Slow. Size 2-|-.
in 1.4—out 3.3.—Slow. Size 2. Dimly seen.
in 4.9—out 1.6.—Fast. Size 1. Dimly seen.
in 4.8—out 3.7.—Fast. Size 1-|-. Indistinct.
in 3.7—out 2.8.—Slow. Size 3. Wing-strokes plain.
in 3.9—out 3.2.—Fast. Size 1-|-. Apparently close by.
in 4.9—out 2.2.—Size 2.
in 4.5—out 1.5.—Size 2. Wing-strokes plain. Total 18.

DETROIT, Mich., May 13, 1900.

METEOROLOGICAL DATA.

Wind—Very light Southwest.
Temperature—70° at 8:00 P. M.—66° at 12:00.
Atmosphere—Fair.

Total number of birds observed from 8:00 P. M. to 12:00 P. M.—111.

8:15 to 8:30—in 3½—out 1½.—Rapid. Size, small.
in 3½—out 1½.—Rapid. Size, small.
in 3½—out 1½.—Rapid. Size, small.
in 3½—out 1½.—Rapid. Size, small.
in 3½—out 1½.—Rapid. Size, small.
in 3½—out 1½.—Rapid. Size, small.
in 3½—out 1½.—Rapid. Size, small.

in 3½—out 1½.—Rapid. Size, small. Goldfinch (?). Total 8.

8.30 to 8:45—in 3½—out 1½.—Moderate. Size, small.
in 3¾—out 1¼.—Moderate. Size, small.
in 3.0—out 1½.
in 3½—out 2.0.—Slowly. Hawk. Flight like hawk or owl.
in 3.0—out 2.0.
in 3¾—out 1½.—Rapid. Size, small.
in 3¾—out 2.0.—~~Rapid. Size~~, medium. Total 7.

8:45 to ~~9:00—in 4.0—out~~ 1¾.—Size 1.
in 3½—out 1.0.—Size 2.
in 3½—out 2¼.—Size 1.
in 3.0—out 1½.—Size 2.
in 3.0—out 1½.—Size 1.
in 3½—out 1¼.—Size 1.
in 3½—out 1½.—Size 1.
in 3½—out 1½.—Size 1.
in 3½—out 1½.—Size 1.
in 3½—out 2.0.—Size 3. All the above at a fast speed. Total 10.

9:00 to 9:15—in 3½—out 1½.—Slow. Size 3. Curved above center, changing course at right angles.
in 3.0—out 2.0.—Medium. Size 1.
in 3½—out 1½.—Slowly. Size 3. Wings spread.
in 3½—out 1½.—Medium. Size 2.
in 3.0—out 1½.—Rapidly. Size 1.
in 3¾—out 1¼.—Slowly. Size 3-|-. Wing motion seen plainly.
in 3½—out 1½.—Rapid. Size 1.
in 3½—out 1½.—Rapid. Size 1. Total 8.

9:15 to 9:30—in 3.0—out 2.0.—Rapid. Size 1.
in 3.0—out 1½.—Size 1.
in 3½—out 1½.—Size 1.
in 3.0—out 1¼.—Slowly. Size 1.
in 3.0—out 2.0.—Moderate. Size 1.
in 3.0—out 2.0.—Slowly. Size 1—.
in 3½—out 1½.—Rapid. Size 2.
in 3.0—out 1½.—Moderate. Size 2.
in 3¼—out 1½.—Size 2. Very rapid flier. Total 9.

9:30 to 9:45—in 3.0—out 2.0.—Moderate. Size 2.
in 3.0—out 2.0.—Moderate. Size 2.
in 3¾—out 1¾.—Rapidly. Size 1.
in 3½—out 1½.—Slowly. Size 3+. Duck or loon, neck stretched out.
in 3½—out 1¾.—Rapidly.
in 3½—out 1½.
in 3½—out 1½.
in 2½—out 1½.
in 3½—out 4½.—Slowly. Size large. Note direction.
in 3½—out 1½.—Rapidly. Size 3. Total 10.

9:45 to 10:00—in 3½—out 1½.—Rapid. Size 1.
in 3½—out 1½.—Size 2. Appeared to be two birds together.
in 3.0—out 1.0.—Size 1—.
in 3¾—out 1¾.—Slow. Size 3.
in 3½—out 1½.—Rapid. Size 1—.
in 3.0—out 1.0.—Size 2.
in 3½—out 1½.—Size 3.
in 3½—out 1½.—Size 2.
in 3½—out 1½.—Size 1. Goldfinch motion.
in 3½—out 1½.—Very fast. Size 1.
in 3½—out 1½.—Rapid. Size 2.
in 3.0—out 1.0.—Size 2.
in 3½—out 1.0.—Very fast. Size 1. Curved upwards to 1.
in 3.0—out 1¼.—Very fast. Size 3. Total 14.

10:00 to 10:15—in 3½—out 1½.—Rapid. Size 1.
in 3½—out 1½.—Size 1.
in 3½—out 1½.—Moderate. Size 1.
in 3¾—out 1¼.—Size 1.
in 4.0—out 1.0.—Rapid. Size 1.
in 3½—out 1½.—Very slow. Size 2. Wing motions plainly seen.
in 3½—out 1½.—Rapid. Size 1.
in 4.0—out 1.0.—Rapid. Size 1. Total 8.

10:15 to 10:30—in 3½—out 1½.—Rapid. Size 1.
in 4.0—out 1.0.—Size 1.
in 3½—out 1¼.—Size 1.
in 3¼—out 1¾.—Slowly. Size 2.
in 3½—out 1½.—Moderate. Size 3.
in 3½—out 1½.—Moderate. Size 3.

in 3½—out 1½.—Rapid. Size 1. 2 in rapid succession.
in 3¼—out 1¾.—Rapid. Size 1.
in 3½—out 1½.—Rapid. Size 1. Total 9.
10:30 to 10:45—in 3½—out 1½.—Moderate. Size 2.
in 3½—out 1½.—Rapid. Size 1.
in 3½—out 2.0—Moderate. Size 3.
in 3½—out 1½.—Very fast. Size 1.
in 3½—out ½.—Very fast. Size 1+.
in 3½—out 1½.—Moderate. Size 2. Total 6.
10:45 to 11:00—in 3½—out 1½.—Moderate. Size 1.
in 3½—out 2.0.—Very fast. Size 1.
in 3¾—out 1¾.—Rapid. Size 1.
in 3¼—out 1¼.—Very slow. Size 1. Wing motion seen. Took three seconds to cross the field. Total 4.
11:00 to 11:15—in 3½—out 1½.—Fast. Size 1.
in 3½—out 2.0—Slow. Size 3.
in 4¼—out 2¾.—Slow. Size 3. Note direction.
in 3½—out 2¼.—Rapid. Size 1.
in 3½—out 1½.—Rapid. Size 1.
in 3½—out 1½.—Rapid. Size 2.
in 3½—out 1½.—Rapid. Size 2. Total 7.
11:15 to 11:30—in 3½—out 4½.—Rapid. Size 2.
in 3½—out 1½.—Moderate. Size 1.
in 3½—out 2.0.—Moderate. Size 2. Curved over center.
in 3½—out 1½.—Rapid. Size 2. Total 4.
11:30 to 11:45—in 2¼—out 4¾.—Rapid. Size 2. Time 11:32. Total 1.

EXPLANATION OF PLATES.*

Plate I.

Curves drawn from observations collected by means of the telescope at Ann Arbor, Mich., Detroit, Mich., Lake Forest, Ill., and Beloit, Wis. These curves show the number of birds flying in periods of fifteen minutes.

Plate II.

Same as plate I. for Madison, Wis., with the exception that the curves have in each instance been reduced to the same number of hours after moon-rise.

Plate III.

A combined curve of three successive observations taken at Madison, Sept. 11, 12 and 13, 1897. The curve has again been reduced to hours after moon-rise. This combined curve brings out more strikingly the general conditions observed at Madison with reference to the influence of topography upon the number of birds flying.

Plates IV. and V.

In plates IV. and V. each circle represents the field of observation as seen through the telescope when focused on the moon. Each line in the circle represents the flight of one bird, the heavily shaded end showing the direction toward which the bird is flying. The broken lines represent the flight of birds that appeared out of focus. The data from which these two plates were made were taken at Beloit, May 12, 1900.

Plates VI. and VII.

Same as plates IV. and V. for Beloit, May 11, 1900.

Plate VIII.

Same as plates IV. to VII. from data collected at Madison at various times from April 8, 1898, to May 9, 1900. The arrows outside of the circle show the approximate direction for the period. It is to be noted that there are two main directions followed, the one predominating in April, the other in May.

---

*For a clear understanding of the plates it will be necessary to keep the method of observation in mind. See pages 198 to 199 in text.

Plate I.

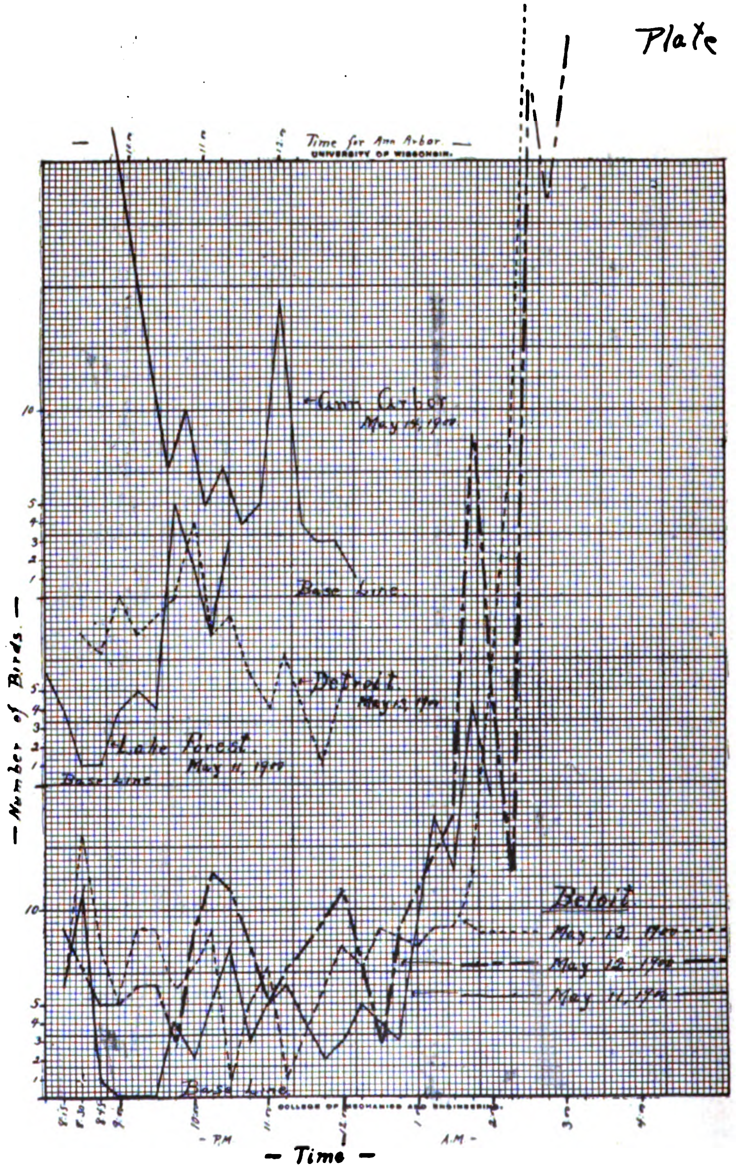

— Time for Ann Arbor —
UNIVERSITY OF WISCONSIN.
11 P.M.
11 P.M.
12 P.M.
10
5
4
3
2
1
Ann Arbor
May 13, 1910
Base Line.
Detroit
May 12, 1910
Lake Forest
May 11, 1910
Base Line
— Number of Birds —
10
5
4
3
2
1
Base Line
Beloit
May 12, 1910
May 12, 1910
May 11, 1910
8.15
8.30
8.45
9 P.M.
10 P.M.
11 P.M.
12 P.M.
1
2
3 A.M.
4 A.M.
COLLEGE OF MECHANICS AND ENGINEERING.
— P.M
A.M —
— Time —

Plate II.

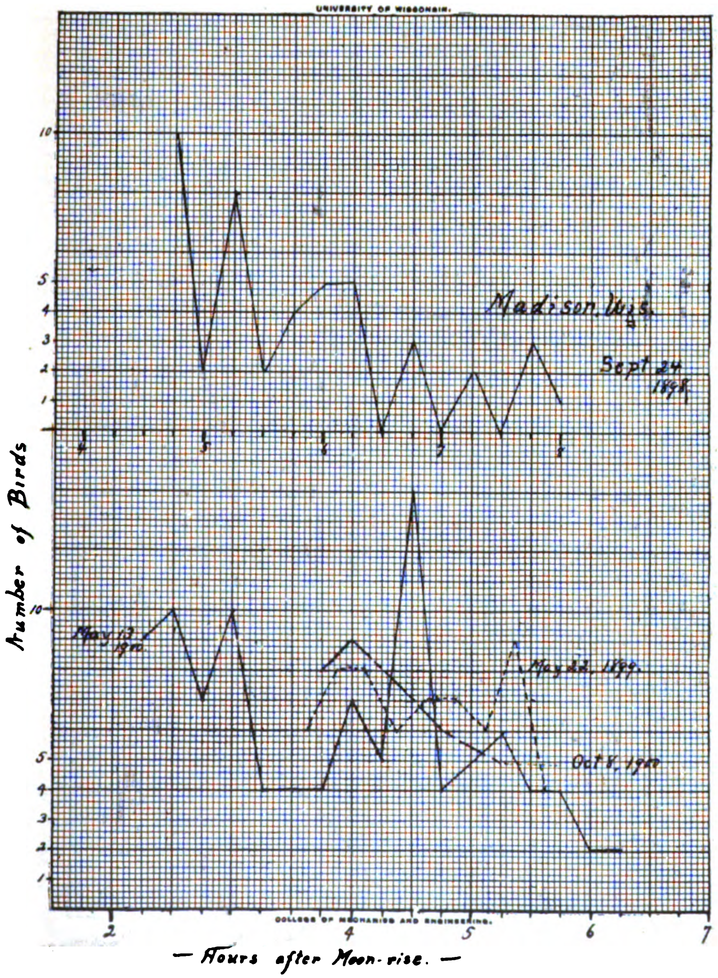

UNIVERSITY OF WISCONSIN.
10
5
4
3
2
1
Madison, Wis.
Sept 24
1898.
4
5
6
7
8
Number of Birds
10
May 13
1900
May 22, 1899.
Oct 8, 1900
5
4
3
2
1
COLLEGE OF MECHANICS AND ENGINEERING.
2
4
5
6
7
— Hours after Moon-rise. —

Plate III.

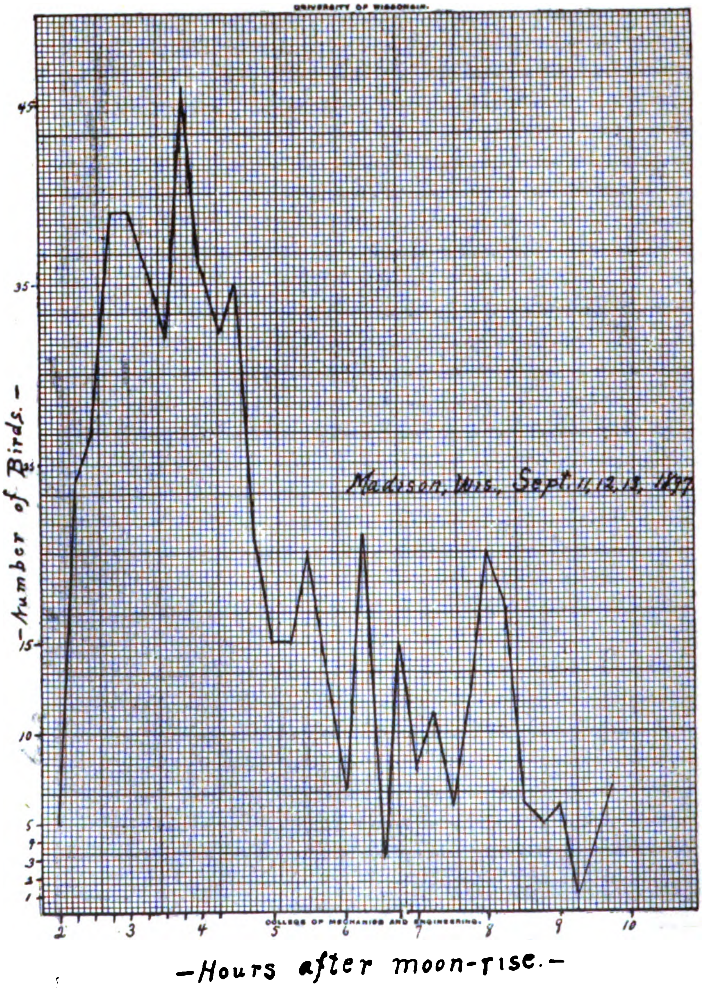

UNIVERSITY OF WISCONSIN.
-Number of Birds.-
45
35
25
15
10
5
4
3
2
1
Madison, Wis., Sept. 11, 12, 13, 1897
2
3
4
5
6
7
8
9
10
COLLEGE OF MECHANICS AND ENGINEERING.
-Hours after moon-rise.-

Plate IV.

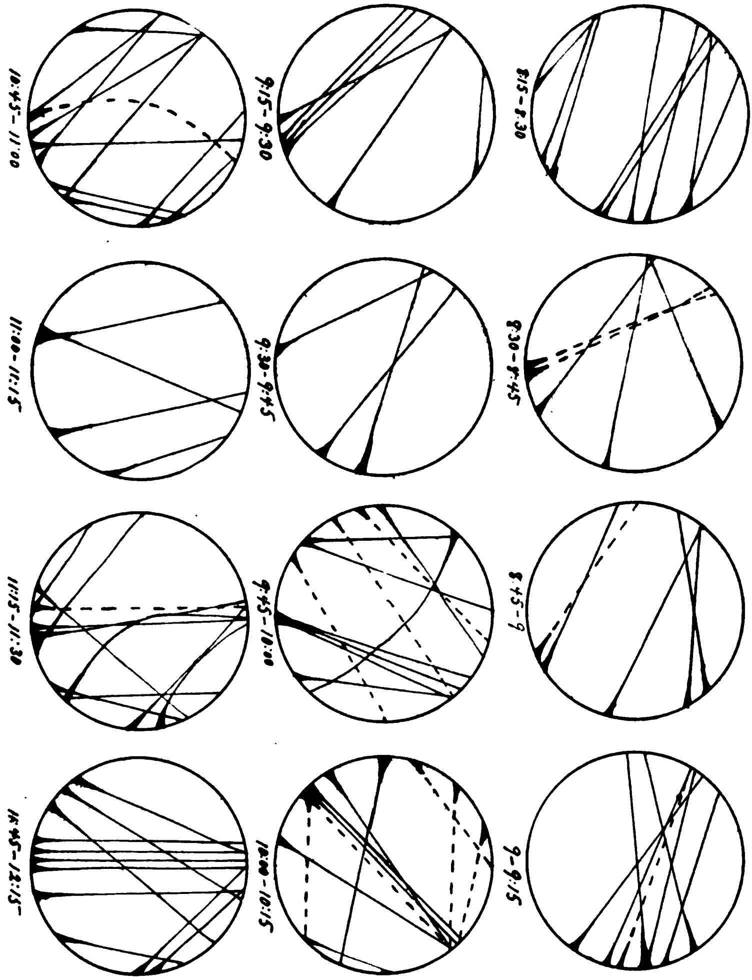

8:15–8:30
8:30–8:45
8:45–9
9–9:15
9:15–9:30
9:30–9:45
9:45–10:00
10:00–10:15
10:45–11:00
11:00–11:15
11:15–11:30
11:45–12:15

Plate V.

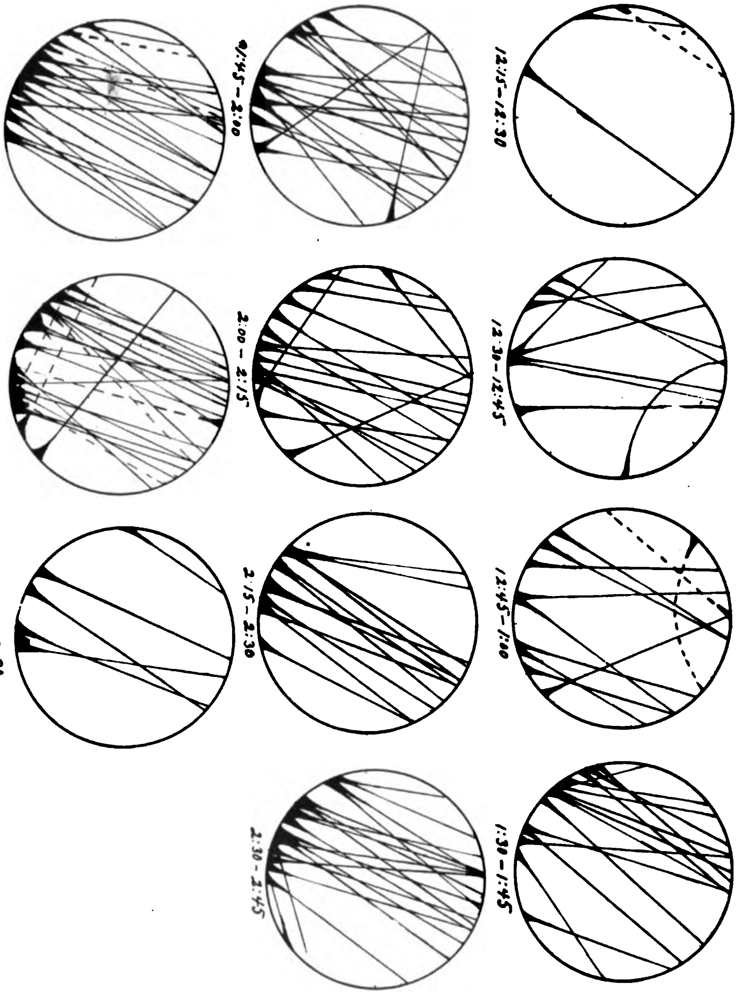

12:15–12:30
12:30–12:45
12:45–1:00
1:30–1:45
1:45–2:00
2:00–2:15
2:15–2:30
2:30–2:45
2:45–3:00
3:00–3:15
3:15–3:30

Plate VI.

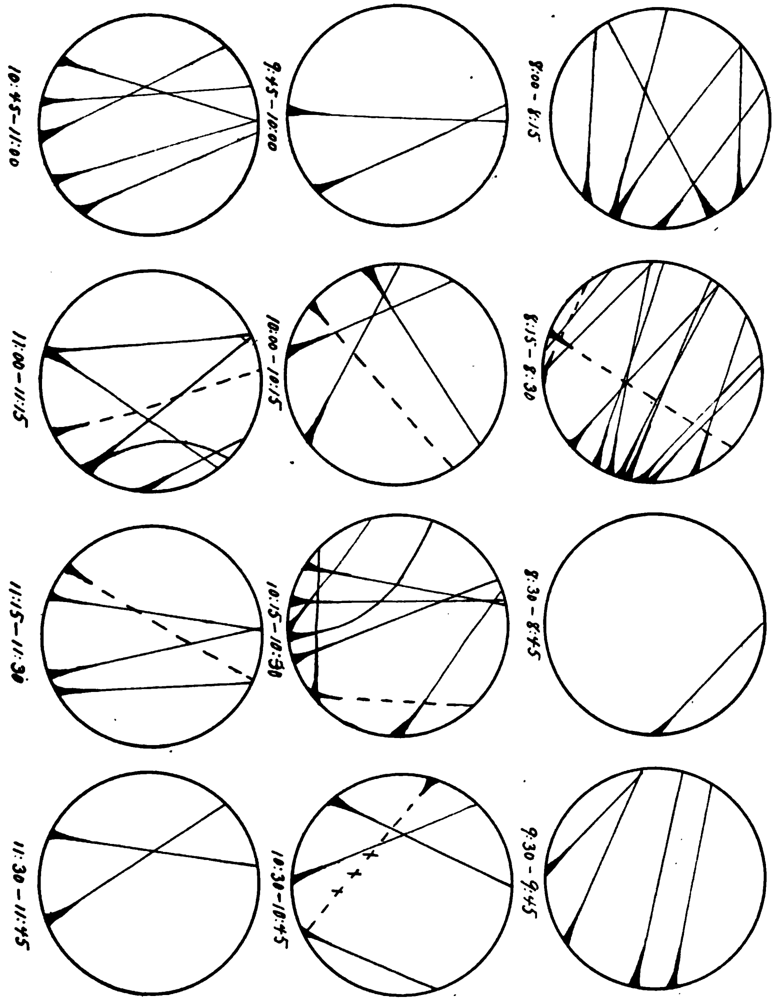

8:00 - 8:15
8:15 - 8:30
8:30 - 8:45
9:30 - 9:45
9:45 - 10:00
10:00 - 10:15
10:15 - 10:30
10:30 - 10:45
10:45 - 11:00
11:00 - 11:15
11:15 - 11:30
11:30 - 11:45

Plate VII.

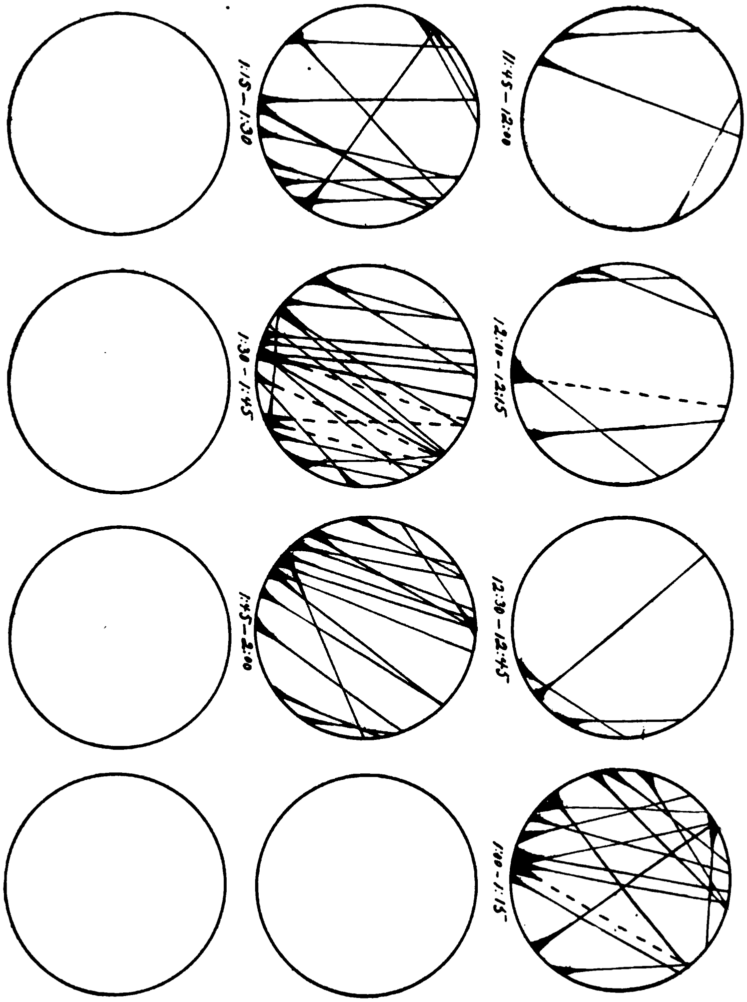
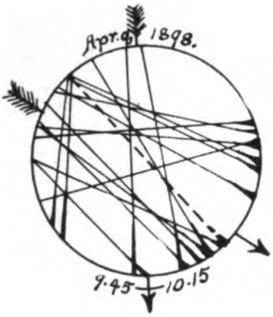
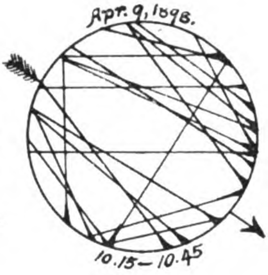
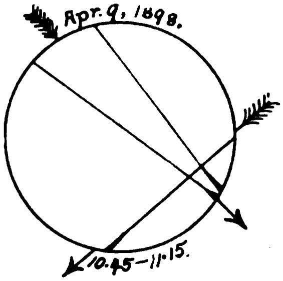
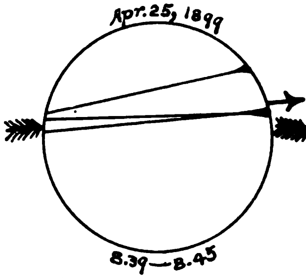


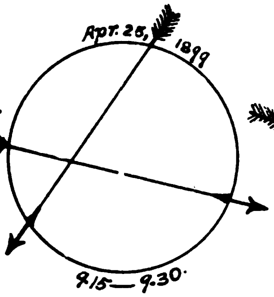
Plate VIII.

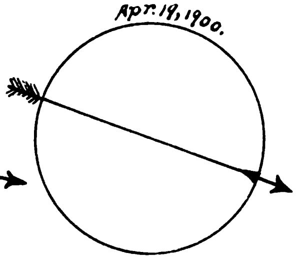

Apr. 9, 1898.
9.45—10.15

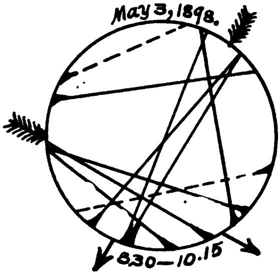

Apr. 9, 1898.
10.15—10.45

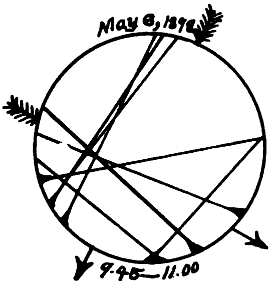

Apr. 9, 1898.
10.45—11.15.

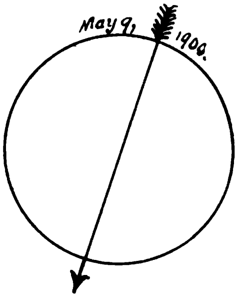

Apr. 25, 1899
8.39—8.45

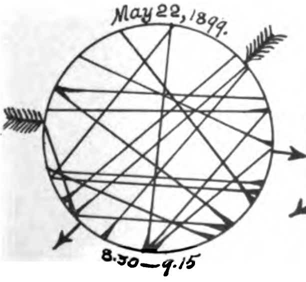

Apr. 25, 1899
9.15—9.30.

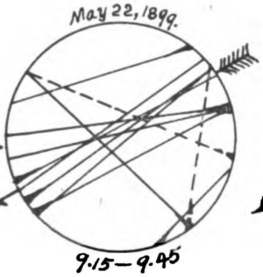

Apr. 19, 1900.

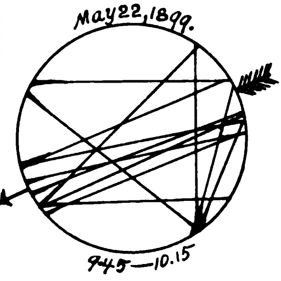

May 3, 1898.
8.30—10.15


May 6, 1898
9.45—11.00


May 9, 1900.


May 22, 1899.
8.30—9.15


May 22, 1899.
9.15—9.45


May 22, 1899.
9.45—10.15

BULLETIN

OF THE

Wisconsin Natural History Society

VOLUME III

(NEW SERIES)

WITH NINE PLATES

MILWAUKEE
1903 — 1905

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14.428

Vol. 3 (NEW SERIES. JANUARY, APRIL, JULY, 1903. Nos. 1, 2 and 3

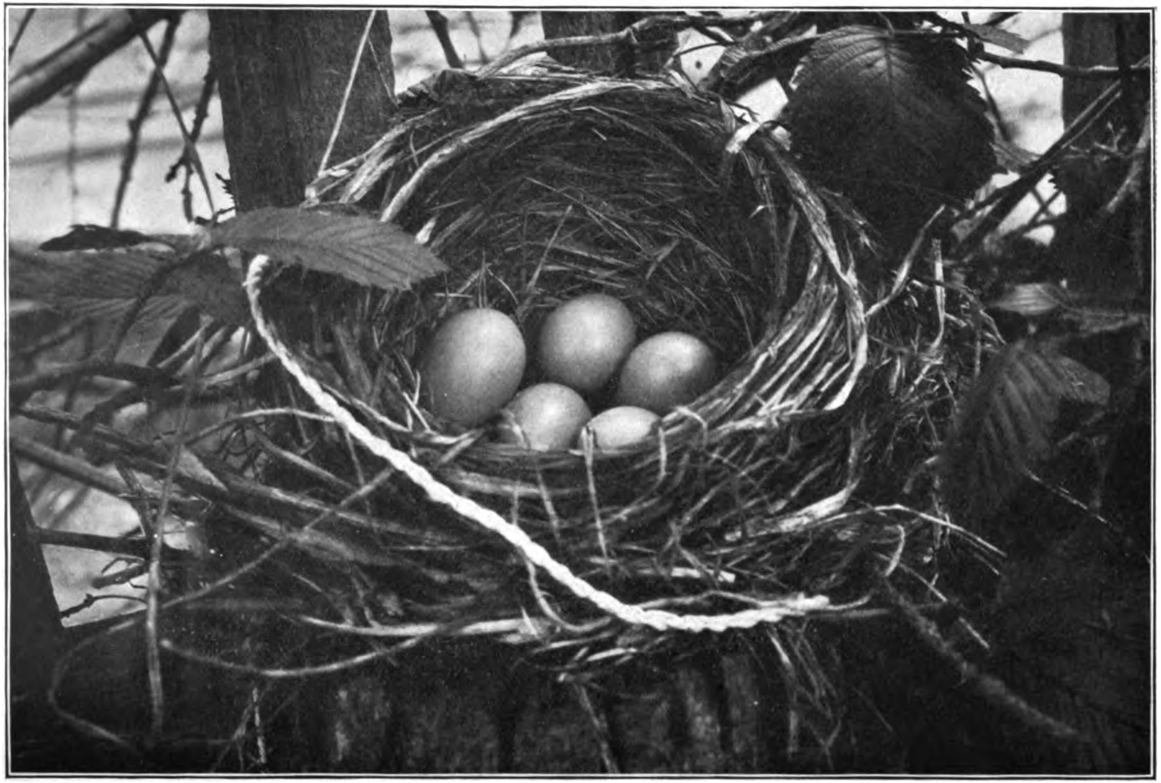
BULLETIN
OF THE
WISCONSIN NATURAL HISTORY SOCIETY

THE BIRDS OF WISCONSIN
By L. KUMLIEN and N. HOLLISTER

PUBLISHED WITH THE CO-OPERATION
OF THE
BOARD OF TRUSTEES
OF THE
MILWAUKEE PUBLIC MUSEUM.

MILWAUKEE, WISCONSIN.

THE EDW. KEOGH PRESS, MILWAUKEE.



NEST AND EGGS OF AMERICAN ROBIN.

Photo. by **F. E. BURROWS.**

JAN 4 1904

Vol. 3. (NEW SERIES) JANUARY, APRIL, JULY, 1903. Nos. 1, 2 and 3

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MILWAUKEE PUBLIC MUSEUM.

MILWAUKEE, WISCONSIN.

The Wisconsin Natural History Society,

MILWAUKEE, WISCONSIN.

ORGANIZED MAY 6, 1857.

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These are all held in the Society's lecture room in the Museum-Library Building, Milwaukee.

Meetings of the combined biological sections take place on the second Thursday of each month at 8 P. M.

General Meetings are on the last Thursday of each month except July and August.

PUBLICATIONS.

The "Bulletin of the Wisconsin Natural History Society."

The future publication of the "Wisconsin Archaeologist" has been assumed by the newly organized Wisconsin Archaeological Society.

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Same (Zweiter Vortrag) Dec. 7, 1885. Dr. Fr. Brendecke, 10 cents.

Bericht des Naturhistorischen Vereins von Wis.,	1871,	10 cents.
“ “ “ “ “ “	1873,	10 “
“ “ “ “ “ “	1874,	10 “
Jahresbericht “ “ “ “ “	1876,	10 “
Jahres-Bericht “ “ “ “ “	1876-77,	10 “
“ “ “ “ “ “ “	1877-78,	10 “
“ “ “ “ “ “ “	1879-80,	10 “
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Proc. of the Nat. Hist. So. of Wis.,	Apl. 6, ’85 to Dec. 7, ’85,	15 cents.
“ “ “ “ “ “ “ “	Jan. 11, ’86 to Dec. 13, ’86,	15 “
“ “ “ “ “ “ “ “	Jan. 23, ’88 to Dec. 17, ’88,	15 “

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“Ant-like Spiders of the Family Attidæ,” G. W. & E. G. Peckham, 1892.

“Spiders of the Marptusa Group of the Family Attidæ,” G. W. & E. G. Peckham, Nov., 1894.

“Spiders of the Homalattus Group of the Family Attidæ,” G. W. & E. G. Peckham, Dec., 1895.

Bulletin of the W. N. H. S. (N. S.), Vol.	I,	No. 1,	Jan. 1900,	50 cents.
“ “ “ “ “ “ “	“	“ 2,	Apl. 1900,	50 “
“ “ “ “ “ “ “	“	“ 3,	July 1900,	50 “
“ “ “ “ “ “ “	“	“ 4,	Oct. 1900,	50 “
“ “ “ “ “ “ “	II,	“ 1,	Jan. 1902,	50 “
“ “ “ “ “ “ “	“	“ 2,	Apl. 1902,	50 “
“ “ “ “ “ “ “	“	“ 3,	July 1902,	50 “
“ “ “ “ “ “ “	“	“ 4,	Oct. 1902,	50 “
“ “ “ “ “ “ “	III,	Triple number, Jan., April and July, 1903,		$1.00.

“The Wisconsin Archæologist,” Vol.	I,	No. 1,	Oct. 1901,	25 cents.
“ “ “ “	“	“ 2,	Jan. 1902,	25 “
“ “ “ “	“	“ 3,	Apl. 1902,	25 “
“ “ “ “	“	“ 4,	July 1902,	25 “
“ “ “ “	II,	“ 1,	Oct. 1902,	25 “

PUBLISHER'S NOTE.

In putting the following paper through the press the Society has been left without assistance from the authors in the correction of proof and preparation of index. Prof. Kumlien's lamented death last winter is a source of sorrow to his many friends. Mr. Hollister has been absent from the state since last May, spending the season in Alaska, where he has been engaged in investigations for the United States Biological Survey. The manuscript received the last touches from his hands early in March. The delay in publication has been due to many causes, not the least among which has been the lack of time on the part of those upon whom the duty of supervising the work of publication has fallen. The greatest pains have been taken to secure accuracy in printing. Some errors, which have been detected too late for correction are pointed out in the list of *errata* following this note.

The expense of publication has been shared by the trustees of the Milwaukee Public Museum, whose generous co-operation is hereby gratefully acknowledged.

Attention is called to the price list of the publications of the Society, printed on the preceding page.

ERRATA.

Page 52 for **Sqatarola** *read* **Squatarola.**
Page 90 for **EVENING GROSBECK** *read* **EVENING GROSBEAK.**
Page 127 for **Hylocichia** *read* **Hylocichla.**

BIRDS OF WISCONSIN.

By L. KUMLIEN and N. HOLLISTER.

PREFATORY NOTE.—The publication of the present list had been contemplated for some time before the actual work on it was begun, about two years ago. For some years past we have been as active as time from other affairs would permit in looking up records, gathering material, and working out, as best we could, those innumerable, obscure and discouraging points, which constantly multiply before one, when an attempt is made to compile an accurate and strictly reliable local list in any branch of biology. Our foremost thought during this period has been to perfect the list whenever an opportunity has presented itself, or could be found.

The result of this work has been, not to enlarge the list of birds supposed to occur within the boundaries of our state, as might reasonably be expected, but actually to reduce the number by eight species! Starting in 1899, with a list of 365 species and sub-species that had been recorded from, or were supposed to have occurred at some time within the state, the number has fallen away from time to time, until now we recognize but 357 in all, that we believe are really entitled to a place, and are therefore embraced in the list proper of the present paper.

This does not necessarily imply that no new species have been added, but rather that many species heretofore considered as belonging to the Wisconsin avifauna are found to be wholly lacking in any authentic record to prove their claim to such a place.

We have made no attempt at descriptions of birds, nor have we gone to any length in discussing their habits. Our whole aim and object has simply been to bring our knowledge of Wisconsin ornithology, as regards occurrence and abundance, up to date, and to present a carefully compiled list of all those species and sub-species which have positively been known to occur within the limits of the state at any time, with as exact, simple, reliable and accurate an account of such occurrence as possible.

THE WORK AHEAD.—Notwithstanding the vast amount of work which has been done in the state, the long period of years represented, and the pleasing results obtained, there are still many points on which the information obtainable is entirely inadequate. The ranges of many conspicuous species, as well as of rarer and more difficult sub-species, are but little known. Some of these, especially the latter, can only be worked out by the accumulation of series of specimens, migratory and breeding, from all parts of the state. Many sections, in fact, whole counties and groups of counties, have been but little worked. Some of these districts will doubtless well repay a careful observer, and furnish valuable material to throw new light on little known problems which now seem so hopelessly perplexing. That section of the state bordering upon the Mississippi River, the whole southwestern part, as well as the more northern counties, are but little known. It is not yet possible to say with certainty just what species may be found breeding in the extreme northern counties, and the western part of our area should furnish several western forms not in this list, as well as additional breeding records now hardly considered possible.

We regret that several combinations of circumstances, including, as greatest of all, the "lack of time," have obliged us to omit from the present paper several subjects of great interest which it was originally intended to include in it. These are the History of Wisconsin Ornithology, Physiography and Bibliography. Much work has already been done on these subjects, especially the latter, and it is hoped that they may at some future time be presented in another paper.

RECORDS.—We have included in the main list only those species and sub-species which we ourselves are thoroughly satisfied have, at some time, occurred in the state, and which have records ***entirely satisfactory to us.*** Our determinations are founded either upon specimens which we have ourselves taken in the field, or have ourselves examined in collections of others, public or private, or upon records made by others whom we have been able to accept as strictly reliable and competent ornithologists. Doubtful species have, following the usual custom, been relegated to a "Hypothetical List," at the end of this paper.

CLASSIFICATION AND NOMENCLATURE.—We have followed the arrangement of higher groups and the sequence of species of the American Ornithologists' Union Check-List of North American Birds. In the matter of nomenclature, however, although following this recognized authority in the main, we have in some cases used names not yet acted upon by the

Committee, and have used as full generic names a number of those as yet considered as of but sub-generic value in the Check List. In all but a few cases these changes have been already made in Ridgway's Birds of North and Middle America, Parts I. and II. We have used only such as seem to us to be correct and likely soon to come into general use and to be recognized by the A. O. U. Committee in time.

SOURCES OF INFORMATION.—The records, notes, and observations herein given are based principally upon our own collections and personal work in the field, covering a large part of the time for periods of thirty-five and fifteen years, respectively. In this time work has been done, more or less thorough, over a large portion of the State. While the greater part by far of the time has been spent in the southeastern counties of Jefferson, Rock, Dane, Milwaukee, Waukesha and Walworth, trips have been made, allowing of extended observations and collections, along the entire length of the shores of Lake Michigan and Lake Superior, the Michigan border, and to different points along the Mississippi River, as well as in a goodly number of the central counties. Added to this, and perhaps of even greater value, has been the use of the extended, accurate and perfectly authentic notes of the late Thure Kumlien, covering a period of constant residence in the state of nearly forty-five years, from 1844 to 1888, making, with the time spent by us in similar work, a total period of sixty years of constant observation, embracing nearly all parts of the state and especially complete for the southeastern portion. Besides the personal acquaintance of the late Dr. P. R. Hoy and Capt. B. F. Goss, we have had the benefit of many letters from these gentlemen to Thure and L. Kumlien for many years. These letters, in many cases, have been of great value in verifying records, and have furnished valuable notes. Mr. J. N. Clark, of Meridian, Dunn County, has contributed a list of the birds noted in that section of the state during over sixteen years of active and careful work, with copious notes on such species as we have especially inquired about. The collections of the Milwaukee Public Museum and of a number of private ornithologists have been carefully gone over.

The published lists of Wisconsin birds have been of great service. Especially worthy of mention in this connection are the following: "Notes on the Ornithology of Wisconsin," by P. R. Hoy, M. D., corrected and reprinted from the Proceedings of the Academy of Natural Sciences of Philadelphia in the Transactions of the Wisconsin State Agricultural Society, Volume II, 1852, pp. 341-364; "Ornithological Fauna of Wisconsin," by Rev. A. Constantine Barry, in the Proceedings of the Boston Society of Natural History, January, 1854; "Economic Relations of Wisconsin Birds." by F. H. King, in the Geology of Wisconsin, Survey of 1873-1879, Vol. I, 1883, pp. 441-610; "On the Birds of Shiocton in Bovina, Outagamie County, Wisconsin, 1881-83," by F. L. Grundtvig (translated by Charles E. Faxon), in the Transactions of the Wisconsin Academy of Sciences, Arts and Letters, Vol. X, 1894-1895, pp. 73-158. It has also been found expedient constantly to consult Mr. E. W. Nelson's "Birds of Northeastern Illinois," Bulletin of the Essex Institute, Vol. VIII, pp. 90-155. Many valuable notes have also been found in minor lists, in Baird, Brewer and Ridgway's "History of North American Birds," and in the files of the Auk, Nidologist, Osprey, Wisconsin Naturalist, Bulletin of the Wisconsin Natural History Society, etc., etc.

ACKNOWLEDGMENTS are due to many Wisconsin ornithologists for valuable help in the preparation of the list. To Messrs. J. N. Clark, H. Russel, H. L. Skavlem, Wm. J. Bennetts, S. R. Hartwell, H. H. T. Jackson, H. A. Winkenwerder, and Drs. H. V. Ogden and E. Copeland, who have furnished notes and suggestions, or allowed us to examine their collections; to Mr. and Mrs. Wm. Henry Miller for kindly making it possible for us to inspect the Hoy collection, now in their possession; to Mr. Witmer Stone, of the Philadelphia Academy of Sciences, for various kindnesses; and especially to Mr. William Brewster, who has examined and determined many specimens for us; we wish to express our sincere thanks.

Delavan, Wis., March 7, 1903.

THE BIRDS OF WISCONSIN.

ORDER PYGOPODES: DIVING BIRDS.

FAMILY PODICIPIDÆ: GREBES.

Æchmophorus occidentalis *(Lawr.).* **WESTERN GREBE.**

One specimen in the collection of L. Kumlien, killed with a pitchfork, from a bunch of six in an air-hole in the ice on Lake Koshkonong, January 4, 1878. Another specimen formerly in the collection of Thure Kumlien, now mounted and in the collection of the Oshkosh Normal School, was taken on Lake Koshkonong, October, 1881, (1) by F. Kumlien. The former does not appear to have been sexed, the latter is a female. We are positive we have seen others, but they are very rare in Wisconsin.

Colymbus holbœllii *(Reinh.).* **HOLBŒLL'S GREBE.**

Holbœll's grebe is found sparingly in March and early April on most of the larger inland lakes and rivers, as well as on Lake Michigan, and again from September, but more often from October, until the ice forms. Where there is open water, both on Lake Michigan and in the interior, many remain all winter. There is some obscurity in regard to the larger grebes in Wisconsin, and this without perpetuating the error of retaining *cristatus*. We are obliged to discard some of the early day records for the reason that the nomenclature has been so muddled that it cannot, with certainty, be unravelled. We have seen a young grebe, less than half grown, taken near the City of Green Bay, which is in all probability this species. There is no doubt that *some* large grebe nests, or did nest, rarely in Northern Wisconsin, and it seems not at all unlikely that it is ***holbœllii***.

Colymbus auritus *Linn.* **HORNED GREBE.**

Still fairly common as a spring and autumn migrant. Not infrequently nests in the northern part of the state, as it

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1. Not 1891, as labeled.

formerly did even in the southern tier of counties. Young a few days old were procured at Lake Koshkonong during June, 1880. Few of our birds have suffered more from the depredations of the plume hunter, than has this species.

Colymbus nigricollis californicus *(Heerm.).* **AMERICAN EARED GREBE.**

Very rare in Wisconsin. We have received two spring specimens from near Iron River, Bayfield County, but have never personally come upon or taken one in Wisconsin. Mr. H. A. Winkenwerder, of Watertown, Wis., has sent us a wing of this species, which is said to have come from a bird shot at that place. We suspect the bird to be a rather rare migrant in the western part of the state, and possibly to breed in small numbers in the extreme northwestern portion. Mr. E. W. Nelson, in 1876, says of this species (1): "Not uncommon in winter upon Lake Michigan." This is certainly good authority, but entirely contrary to our observation.

Podilymbus podiceps *(Linn.).* **PIED-BILLED GREBE.**

A common summer resident in all suitable localities. It arrives in southern Wisconsin early in April, if an average season, and remains until the ice forms, usually in November. Apparently has not decreased in numbers during the past forty years.

FAMILY GAVIIDÆ: LOONS.

Gavia imber *(Gunn.).* **LOON.**

This loon may be found on Wisconsin waters almost any month of the year, and during March and April is a common migrant on all inland lakes and streams. In autumn it is less common inland, but occurs plentifully on Lake Michigan and the Mississippi River. A number remain all winter on Lake Michigan. It was formerly a common breeder on the small lakes from the southern tier of counties northward. Thirty years ago it bred on Lake Koshkonong and many other small lakes where it now occurs only during the migrations. A few nested at Delavan lake up to 1888, and possibly a straggling pair now and then for a few years later. Farther north, where the country is less thickly settled, many still breed. Extremely variable in size, there being a range of variation of from six to

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1. "Birds of Northeastern Illinois"; Bulletin of the Essex Institute VIII. p. 150.

eight inches in length. There is no record of *G. adamsii*, but in 1860, Thure Kumlien received a spring loon which had a pale bill, nearly white at tip, gradually fading into a dull straw yellow, and nearly normal at the base. In no other respect, however, he states in his notes, did it differ from typical *imber*.

Gavia arctica *(Linn.)*. **BLACK-THROATED LOON.**

This is certainly a very rare bird in Wisconsin, occurring only as a straggler in late fall or winter. We have access to but three unquestionable records. One was shot on Rock River, near Janesville, late in the winter of 1860, and mounted for the owner, a gentleman from Rockford, Ill. This was an immature specimen, still showing many traces of the winter plumage. Another, taken at Racine, was preserved in the Hoy collection; and another, taken at Milwaukee, is also on record.

Gavia lumme *(Gunn.)*. **RED-THROATED LOON.**

"Very common winter resident upon Lake Michigan" (Nelson, 1877). "Not uncommon during winter" (Hoy, 1852). From my own observations I find this species a regular and common resident of Lake Michigan in winter. During the unusually severe winter of 1880-81, when Lake Michigan at Milwaukee was frozen nearly or quite across in places, large numbers of this species were seen off that city, and many were caught. They could be seen huddled together on the ice, some dead and others nearly famished. Such as survived until spring were uncommonly tardy in their northward migration, especially as the spring was unusually backward. The following June (1881) I saw a dozen or more on the rocks at the "Door" (the extreme northern end of Door County, between Lake Michigan and Green Bay), and coupling this with a quantity of second-hand information, made a record to the effect that they were breeding. Possibly they were, but with the mature judgment of later years I should have been much slower in considering the evidence conclusive. Many, if not all, of the birds were in full summer plumage, but I have since learned on more than one occasion, that the presence of birds in a given locality in summer is not evidence that they are nesting (L. K.). On the larger inland lakes and streams the red-throated loon is seldom seen in spring, but occurs sparingly during October and November, or until the ice forms. Specimens in full plumage are rarely taken in Wisconsin.

FAMILY ALCIDÆ: AUKS, MURRES AND PUFFINS.

Synthliboramphus antiquus *(Gmel.).* **ANCIENT MURRELET.**

A single specimen of this species was shot in October, 1882, on Lake Koshkonong, by Rev. G. E. Gordon, of Milwaukee. Its occurrence there was, of course, purely accidental. As the opportunity occurs we will here correct one of the numerous errors in that most unfortunate bulletin, "The Birds of Michigan," by A. J. Cook, where other specimens of this species are accredited to Wisconsin as having been taken by us (1). This is an utterly unaccountable error. The bird taken by Mr. Gordon and noted in the Auk of January, 1884, by Mr. Geo. B. Sennett, is unquestionably the only Wisconsin record.

ORDER LONGIPENNES: LONG-WINGED SWIMMERS.

FAMILY STERCORARIIDÆ: SKUAS AND JAEGERS.

Stercorarius pomarinus *(Temm.)* **POMARINE JAEGER.**

Rare winter visitor on Lake Michigan. Early in October, 1879, we saw three specimens of this jaeger on Green Bay. They were close about the boat while the fishermen were emptying their nets, and we had the opportunity of watching them for an hour or more. A week later we had a letter from Thure Kumlien, at Lake Koshkonong, informing us that he had secured one specimen from a group of three that had visited the lake. Another was secured later in the fall by a hunter and mounted for him. We have positively seen this bird on several occasions on Lake Michigan late in the fall. It is recorded by Nelson from Evanston and Chicago.

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1. Where Mr. Cook obtained all these records, I am unable to say. Mr. Gordon's bird was sent to Milwaukee to be mounted; a friend called my attention to it, and as the taxidermist's chief interest in the bird was to get his pay for the mounting, I induced him to let me take it. I made a colored drawing and sent it to Prof. Ridgway. In the meantime the owner called for his bird and I had to give it up. My notice prepared for the Auk did not reach the editors until after the late Mr. Sennett's article. From this information Mr. Cook may have made his unfortunate blunder.—L. K.

FAMILY LARIDÆ: GULLS AND TERNS.

Larus glaucus *Brünn.* **GLAUCOUS GULL.**

Rare winter visitant on Lake Michigan. Dr. Hoy obtained three specimens at Racine (1) and saw others during severe winters. In the Milwaukee Public Museum are three specimens procured at Milwaukee, January 8, 12 and 14, 1895. We are positive of having seen this species on several occasions during winter while engaged in Fish Commission work on Lake Michigan. One large specimen was caught on a herring-baited hook, but was washed overboard and lost. There is difficulty in discriminating between this species and the next, so it is impossible to say which occurs most frequently, but we are inclined to think that *leucopterus* is much more often seen.

Larus leucopterus *Faber.* **ICELAND GULL.**

A regular winter visitant on Lake Michigan, but by no means common, although occuring more frequently than *glaucus*. We know of no record for the interior.

Larus marinus *Linn.* **GREAT BLACK-BACKED GULL.**

We have seen this well-marked species on Lake Michigan, at the Milwaukee light house, mid-winter 1880-1, and on at least two occasions out on the lake. It is, however, rare. According to Nelson, not an uncommon winter resident upon Lake Michigan. Also recorded in Ridgway's List of Birds of Illinois (1874), on the authority of Dr. Velie, of Chicago. Given as common at Racine by Rev. A. Constantine Barry (2), but Dr. Hoy's list of 1852 does not include it, although his observations were made at about the same time and at the same place. Dr. Hoy admitted the species, however, at a later date. A specimen mounted for the Oshkosh Normal School was labeled "Lake Michigan."

Larus argentatus *Brünn.* **HERRING GULL.**

Very common on Lake Michigan at almost all seasons, and a common migrant on all suitable waters of the state. Nests commonly on different islands of Green Bay, and on the north shore of Lake Michigan. Immature birds, not breeding, may be found on any of the larger inland lakes during the summer. Remains throughout the winter wherever there is open water, and is especially frequent at this season about the larger harbors. Not nearly as numerous as formerly.

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1. Nelson, Birds N. E. Ill.
2. Ornithological Fauna of Wis., Proc. Boston Soc. Nat. His. Jan. 1854.

Larus delawarensis *Ord.* **RING-BILLED GULL.**

A common migrant, spring and fall, but does not occur in such numbers as the preceding. It is commonly met late in November, and during mild winters still later, but the majority seem to move further south on the approach of severe weather. Large numbers pass up and down the Mississippi River in the spring and fall. Formerly bred on Spider and Strawberry Islands, Green Bay, from which localities we have eggs (L. K., 1879-81-82). In 1860 it bred as far south as Lake Koshkonong, as at least one instance was recorded by T. Kumlien—a nest of three eggs in a marsh among the black terns. Immature birds are found all summer at the fishing stations and larger harbors, as well as on the inland lakes and larger streams.

Larus atricilla *Linn.* **LAUGHING GULL.**

The only known Wisconsin record for this species is that of Thure Kumlien, who shot a single specimen on Lake Koshkonong in July, 1860 (1). We find that Cook's "Birds of Michigan," 1893, says: "Very abundant on the Great Lakes; probably breeds in the northern peninsula (Gibbs' Birds of Michigan)." If this is correctly quoted it is surely a gross error. The same list, quoting Dr. A. K. Fisher, says: "Very rare north, if it occurs at all," and states that L. Kumlien says it is "fairly common" (2). Inasmuch as we seriously doubt that the bird ever visits Lake Michigan, except perhaps as an accidental straggler, the absurdity of the latter mis-quotation is apparent.

Larus franklinii *Sw. and Rich.* **FRANKLIN'S GULL.**

Not common, but of regular occurrence in the eastern part of the state as a fall migrant, from September until the small lakes and rivers are closed by ice. There are but two records of its capture in Walworth County, but it is taken yearly on Lake Koshkonong in September and October. Near Rockdale, Dane County, it was noted in considerable numbers following the teams that were plowing on the prairie in May, 1870. This is the only appearance of the spring birds we have ever noted in eastern or central Wisconsin. Mr. J. N. Clark reports it in September, in Dunn County, and along the Mississippi it is not at all rare. On Lake Michigan it is less

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1. B., B. and R., N. A. Birds, Vol. II. p. 257.
2. Very few have had the opportunity for observing the gulls on Lake Michigan that we have had, and we have never seen a specimen of *Larus atricilla* here.—L. K.

common than anywhere in the interior, and Dr. Hoy, in 1852, says: "Visits us only in severe winters. Rare." It is easy to see how the doctor came to make this statement, as the bird is not a lake gull or a winter resident, and the only birds he met at Racine were late stragglers, and he supposed them to occur at this season only. It seems remarkable that so few spring specimens are obtained in eastern Wisconsin. In fact, birds in breeding plumage are, except along the Mississippi, decidedly rare in the state.

Larus philadelphia *(Ord.)*. **BONAPARTE'S GULL.**

The systematic slaughter of this beautiful gull for millinery purposes has so reduced its numbers that we can no longer claim it as our most abundant species. We are informed on good authority that for several seasons, in May, between 1880 and 1888, two men from Chicago regularly visited Lake Koshkonong to shoot this gull for its plumage. Report says "thousands" were killed, and that when the gulls left for more northern waters the plume hunters followed—how far we know not. These men reported that there were many others employed, and they visited such lakes as the gulls frequented in numbers each season. From about 1865 to 1875 it was a sight worth seeing when hundreds, perhaps thousands, of these birds commenced to flock together on Lake Koshkonong, and with one accord began their circling flight northward. These vast flocks passed directly over our house as they left the lake, and many a time have we watched them, rising higher and higher, and gradually fading from view. In the same locality at the present day very few are seen, either in spring or fall, although small flocks are of regular occurrence on any of the larger lakes. In 1880 a few were said to breed on Chambers' Island, Green Bay, and we saw on some small islands in Big Bay de Noquet, Michigan, a number of nests like pigeons nests on the flat branches of low coniferous trees that without question had been used by these birds. Many full-plumaged birds were seen and numbers of young, but only one so young as to be still unable to fly. When this species was common, from 1865 to 1880, it generally put in an appearance in southern Wisconsin during the first week of April, remaining to or past the middle of May. Immature birds remained the entire summer. The fall migration began sometimes as early as the middle of August and a few remained until the ice formed. A few remain until mid-winter, especially on Lake Michigan, but as a rule it is not a winter resident.

Xema sabinii *(Sab.).* **SABINE'S GULL.**

A young male was shot on Delavan Lake, Walworth County, October 7, 1900, by Mr. H. P. Hare, and is now preserved in the collection of N. Hollister. This is probably the only authenticated Wisconsin specimen extant. Dr. Hoy reported it as having been seen by him at Racine in November, 1853. Mr. E. W. Nelson is also positive of having shot a specimen on the shore of Lake Michigan, near Chicago, the first of April, 1873, but the bird was blown out into the lake and lost. In April, 1897, we examined and identified two fresh wings of this species, brought to a taxidermist in Janesville to be prepared for a hat. This bird was killed on Rock River, near that city.

Sterna caspia *Pall.* **CASPIAN TERN.**

Not common, except, perhaps, on northern Lake Michigan and Green Bay. Breeds, or did in 1879-80-81-84, and 1893, on different islands in Green Bay and on the north shore. Frequently found on Lake Michigan in winter. Visits irregularly the larger inland lakes. A large flock appeared on Lake Koshkonong, May 29, 1896, from which fine specimens were shot by L. K. Also noted on Lake Koshkonong a number of times during the summer. Not noted by Hoy in his list of 1852, and consequently not found in King's list of 1879, the latter being chiefly a compilation from Hoy.

Sterna forsteri *Nutt.* **FORSTER'S TERN.**

A common migrant during the first two or three weeks of May, and again from September until the middle of October; and still later on Lake Michigan. Such birds as breed in the state often scatter after the nesting season, and both old and young are often found in August. Not nearly as numerous as formerly. Although the larger part are migratory a good many still nest within the state, principally in the small reedy lakes, even in the southern counties. In June, 1872, a large number, not less than two hundred pairs, nested at Lake Koshkonong. The nests were mostly roughly heaped up masses of the dead stems of the cane (*Phragmites phragmites*), placed close together, often a dozen or more in a cluster, and situated in the more open spaces among the year's growth of the cane. Plenty as were the nests and eggs, still we had the greatest difficulty in getting even two or three positively identified sets, as the discovery was soon made that all were not *forsteri*, but many *hirundo*, and a few *paradisæa*. As the day was warm with bright sunshine the birds did not stay on their nests, but the entire colony was constantly hovering over us. It was only toward night, as a bird would settle on its nest and could be shot as it arose that we succeeded in identifying and procuring a few sets of *forsteri* and *hirundo*. A second visit to the colony a week later was of even more interest, for then the nestlings were out in force; but it was utterly impossible to distinguish them. As far as our observation goes *forsteri* prefers the small reedy, inland lakes for breeding purposes, while *hirundo* is more often found on the islands of Lake Michigan and Green Bay.

Sterna hirundo *Linn.* **COMMON TERN.**

Formerly, at least up to 1880, a very common migrant, at about the same dates as the preceding. More common on Lake Michigan than *forsteri*, and more abundant here than in the interior of the state, preferring the gravelly or sandy islands of the lake and Green Bay for nesting places, rather than the smaller inland lakes. Very greatly diminished in numbers during the last quarter of a century.

Sterna paradisæa *Brünn.* **ARCTIC TERN.**

A somewhat irregular migrant, at times fairly common, and again quite the opposite. We have taken it nesting in Green Bay, 1879, and in June, 1891, procured a set of eggs—the parent shot on the nest—at Lake Koshkonong. These nesting records are, however, to be considered as exceptional. May 27, 1899, Mr. H. H. T. Jackson, of Milton, found a dead specimen of this species, partly devoured by some animal, on a muskrat house in a small lake half a mile from Milton. This bird proved to be a female and contained two nearly perfect eggs. Less common in the fall than in the spring, less often met inland in the fall than the two preceding, and not as abundant as either at any time or place in the state, this species was evidently entirely overlooked by Dr. Hoy, Rev. Mr. Barry and others, as it was for many years by Thure Kumlien. It arrives a little earlier in the spring than either *forsteri* or *hirundo*. It is readily distinguished from either of these by its smaller, redder bill and *much* darker underparts.

Sterna antillarum *(Less.).* **LEAST TERN.**

This species can be considered only as a very rare summer visitor from the south. In June, 1893, three full-plumaged birds were shot by L. Kumlien at Black Hawk Island, Lake Koshkonong, among a large colony of black terns. Another specimen is, or was, preserved in a store in Janesville, said to have been shot on Rock River near that city. There is also one Milwaukee record of which we are sure, but we are unable to find the date. Rev. A. Constantine Barry, in his list of 1854, says: "Not so common as the black tern and probably does not breed in the state." Not included in Hoy's list of 1852.

Hydrochelidon nigra surinamensis *(Gmel.).* **BLACK TERN.**

A very common summer resident in all the inland ponds, sloughs, wet marshes and lakes, but seldom found on Lake Michigan, and probably only during migrations. Arrives in Wisconsin, of an average year, the first few days of May—dates of arrival for a number of years at Lake Koshkonong range from April 16 to May 11—and departs early, few being seen after the middle of September. When they arrive in the spring all are in the black, full breeding plumage; and all are in the white winter plumage before they leave; in fact, a great many begin to assume their winter plumage before they are through nesting. Not as plenty as formerly, still their numbers have not decreased anything like those of the common or Forster's Tern.

Hydrochelidon leucoptera *(Meisn. and Schinz).* **WHITE-WINGED BLACK TERN.**

The only known instance of the occurrence of this species on the western continent is that of a breeding female shot by L. Kumlien in a large marsh near Black Hawk Island, Lake Koshkonong, July 5, 1873. The specimen was sent freshly skinned to Dr. Brewer and was presented by him to the National Museum. The partially denuded abdomen and well formed ova prove that it would have bred—whether with its own kind or with the common species we know not, as no others were seen at the time nor since, although days have been spent in the tern colonies for almost no other purpose than the vain hope of seeing more of them. The bird was quite noticeable among the enormous numbers of black terns—so much so that there is no special need for any one to sacrifice the life of any of the common species under the delusion that it may prove to be *leucoptera* when in hand.

ORDER STEGANOPODES: TOTIPALMATE SWIMMERS.

FAMILY PHALACROCORACIDÆ: CORMORANTS.

Phalacrocorax dilophus *(Swain.).* **DOUBLE-CRESTED CORMORANT.**

Twenty-five to thirty years ago this was a common migrant in suitable waters throughout the state. It arrived as soon as the ice began to loosen in the small lakes, varying with the season from early in March until April, and remained until May first. Even when it was more common, comparatively few were noticed in the interior during the fall, although more plenty on the Mississippi River. Mr. J. N. Clark, writing from Dunn County, reports small flocks along the Chippewa River in spring, but considers them rare there. A few, we think, remain on Lake Michigan during mild winters. During the past five years the cormorant has been more plenty than for many years previous in Walworth County, and doubtless at other suitable places on the line of flight, both in the spring and in the fall. A few used to remain on Lake Koshkonong all summer, but we have never found them nesting, as they probably do in certain counties of the northern part of the state. Mr. Chas. F. Carr (1), now of New London, Wisconsin, is authority for the statement that "they breed about some of the larger, isolated lakes in the northern and central part of the state," and "feed at a considerable distance from the vicinity of their nesting haunts, and when leaving and returning fly at a great height."

FAMILY PELECANIDÆ: PELICANS.

Pelecanus erythrorhynchos *Gmel.* **AMERICAN WHITE PELICAN.**

This once abundant species is now chiefly found along the Mississippi River during spring migrations. In past years we have observed great flocks of them on Lake Koshkonong in April, and often well into May, and we never tired of watching them swim up some bay, and forming a line across, slowly move toward the shore, nearly every bird with head and neck under water. When a fish was captured the head was raised until the bill was nearly vertical, and the fish, or as much of it as there was room for, swallowed. At these times they were

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1. Wis. Naturalist, I-2, Sep. 1890.

anything but shy, and were, in fact, easily approached. During the past ten years we know of but one specimen having been taken on Lake Koshkonong, a juvenile, in July, 1892, and only one small flock seen. Two or three were killed on Duck Lake, Walworth County, about 1888, three seen on Delavan Lake June 6, 1895, and one specimen, a single female, was shot in the inlet of Delavan Lake, September 4, 1898, which is now in the collection of N. H. Mr. J. N. Clark reports but two instances of the occurrence of pelicans in Dunn County during many years' observations, these in 1891, and considers them very rare there. In 1883 we visited abandoned rookeries in the western part of the State, and we are reliably informed that a very few nested northeast of Merrill in 1884. Probably few, if any, nest in the state at the present time; in fact this is fast becoming one of our rarer birds. Did not seem to frequent Lake Michigan to any extent even when common inland.

FAMILY FREGATIDÆ: MAN-O'-WAR BIRDS.

Fregata aquila *Linn.* **MAN-O'-WAR BIRD.**

A single straggler of this species was shot in the Milwaukee river, at Humboldt, near the city of Milwaukee, in August, 1880. The bird was sitting on a rock projecting out of the shallow water, and was shot by a boy with a pistol. The specimen is now mounted in the Milwaukee Public Museum.

ORDER ANSERES: LAMELLIROSTRAL SWIMMERS.

FAMILY ANATIDÆ: DUCKS, GEESE, AND SWANS.

Merganser americanus *(Cass.).* **AMERICAN MERGANSER.**

Common as a migrant, arriving in the spring as soon as there is any open water — in fact, a few remain all winter wherever it is not frozen, about spring fed creeks. Said to nest on the extreme northern end of Door County. We have seen them in this locality in summer and also at different places on the south shore of Lake Superior in July and August. Fully as common as thirty years ago.

Merganser serrator *(Linn.).* **RED-BREASTED MERGANSER.**

Common during migrations, but not in as great numbers as the preceding. A regular breeder about Green Bay and Lake Superior. We have nesting records for Green Bay up to June, 1886. Our observation has been that it is much more common in the eastern than in the western part of the state, and is not as liable to remain all winter as is *M. americanus*.

Lophodytes cucullatus *(Linn.).* **HOODED MERGANSER.**

Very common, sometimes fairly abundant, in most sections of the state, although for some reason not apparent it does not frequent all sections alike. Where there is open water, as in Lake Michigan, and, in mild winters, portions of the larger inland lakes, it remains all winter. Breeds sparingly, in suitable localities, from the southern tier of counties northward. Unlike the last two this "fish duck" is most often of excellent flavor, and is considered by many local gunners as superior to the blue-bill, whistler, butterball, and many other sea ducks.

Anas boschas *Linn.* **MALLARD.**

Still abundant as a migrant, and, in Southern Wisconsin, as a winter resident. Here large numbers remain on the prairies all winter, feeding in the corn fields and resorting to the open springs and spring runs at night. At the present time the mallard nests but sparingly in the localities where it was formerly a common breeder, still clinging, however, to any suitable locality when not too much disturbed in late spring.

Anas obscura *Gmel.* **BLACK DUCK.**

Typical *obscura* is rather rare in Wisconsin. A few are found during the spring migrations, and some nest each year throughout the interior of the state, where they are much more common than on Lake Michigan. We have shot young, not yet able to fly, in Green Bay in August, presumably of this race, and a limited number formerly nested in Horicon Marsh. About Delavan specimens are sometimes taken on tne opening day of the ducking season, September 1, when it is still very hot and unlikely that any migration has commenced.

Anas obscura rubripes *Brewst.* **RED-LEGGED BLACK DUCK.**

This is the common form of the "black mallard" which is shot in Wisconsin during the fall flight and, in the southern counties, throughout the entire winter. Mr. Brewster has kindly examined five selected specimens, taken during winter and early spring at Delavan and about Milton, and pronounces four of them typical *rubripes* and one intermediate. Usually found in company with large flocks of mallards which frequent the prairie cornfields and open spring-holes during the winter.

Chaulelasmus streperus *(Linn.).* **GADWALL.**

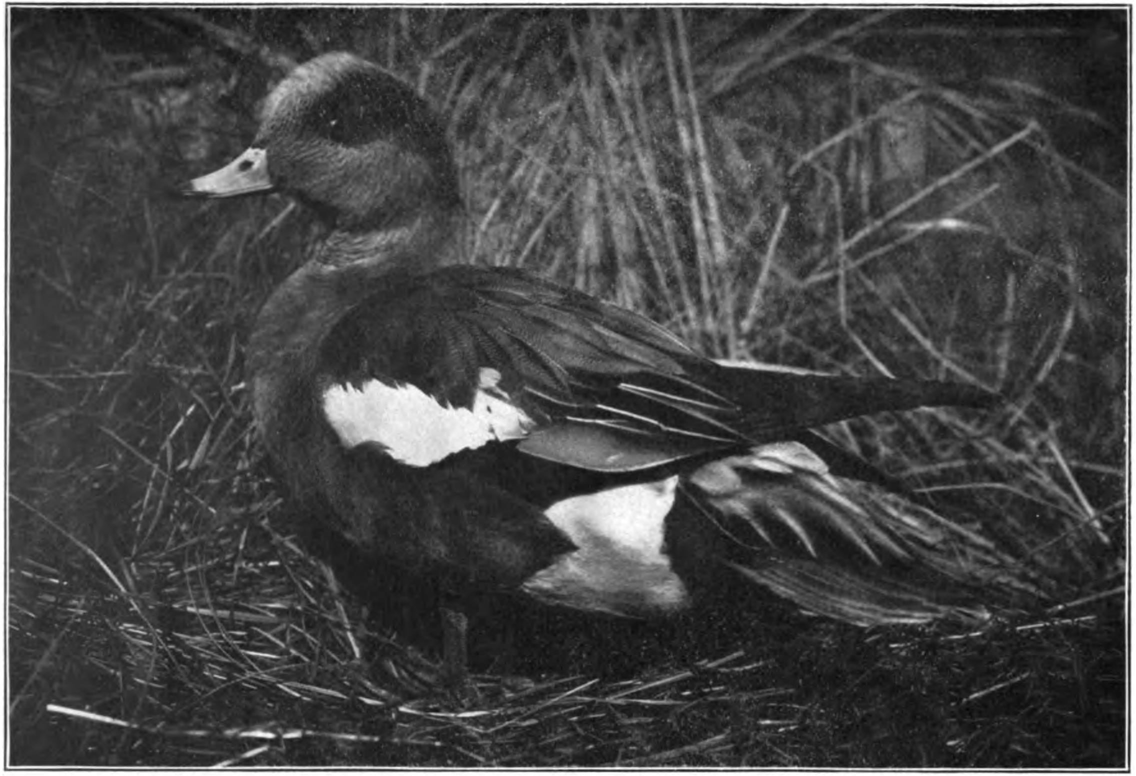
Found principally as a migrant during April and October. Not nearly as common as formerly, in fact, at the present time, not at all common. Known to nest sparingly near Lake Koshkonong twenty-five or more years ago. Capt. Goss found it breeding in Horicon Lake (now Horicon Marsh). Mr. C. F. Carr records it as breeding in the extreme northern part of the state. "Gray widgeon" of the gunners of Southern Wisconsin, when distinguished at all from the baldpate or pintail.

Mareca penelope *(Linn.).* **WIDGEON.**

A specimen of this species was purchased, fresh killed, from a gunner on Lake Mendota in 1874, and one was shot on Lake Koshkonong in 1875 by L. Kumlein. These birds were both adult males. Another adult male was mounted in 1877 by Thure Kumlien for some sportsman, this specimen having also been shot on Lake Koshkonong. An immature male was also seen in a hunter's string of ducks as he boarded the train at Milton Junction, after a few days shooting on Koshkonong. Besides the above there are other records for the state about which there is no doubt.

Mareca americana *(Gmel.).* **BALDPATE.**

Common migrant, spring and fall, but like most of our ducks, in constantly decreasing numbers. Formerly bred sparingly as far south as Lake Koshkonong, Horicon Marsh, etc., now in the less settled portions of the state only. Small flocks of a dozen or more immature males, that do not breed, are found on most of the larger inland lakes all summer. This species is to a considerable extent a parasite of the canvas-back, allowing the latter to dive and bring to the surface a bill full of *Naiadaceae*, and gobbling up the nutlets before the rightful owner can get at them. Known to all the hunters as the "widgeon" or "bald widgeon."



BALDPATE DUCK (Male.)

Photo. from Life by F. E. BURROWS.

Nettion carolinensis *(Gmel.)*. **GREEN-WINGED TEAL.**

An abundant migrant in the spring and fall. As with other ducks, the dates of migration depend entirely on the weather and breaking up or forming of the ice. Of an average season the green-wing arrives early in April, although March records are not infrequent, and large numbers may be found close on to May 1. In fall the majority do not arrive on their southward journey until from the 15th to 30th of September or well into October, and remain in localities where food is plenty until very cold weather. Formerly bred sparingly even in southern Wisconsin, eggs having been taken on Black Hawk Island, Lake Koshkonong, by L. K. in May 1870. At least two other authentic nesting records at this place are known. Farther north they breed more plentifully, but the larger number pass beyond our borders for the summer.

Querquedula discors *(Linn.)*. **BLUE-WINGED TEAL.**

Formerly one of the most abundant of our ducks, but of late years it has greatly diminished in numbers, perhaps more than any other species, although it is at times still plentiful during late spring and early fall migrations. Arrives much later than the green-wing, and leaves again much earlier in the autumn. Used to nest abundantly in all suitable localities in southern Wisconsin. Thirty years ago a blue-winged teal's nest was such a common affair that we seldom stopped even to find the nest when we flushed the duck. Along every grassy stream or ditch, and in all marshes and meadows and even, at times, in grain fields at considerable distances from water, it nested in abundance. A few still summer with us and breed, but it is a mere fraction of what there used to be. Naturally the most unsuspicious of all our ducks, in localities where it was not disturbed it became so tame as to allow a person to approach within a few feet, especially during the spring months.

Querquedula cyanoptera *(Vieill.)*. **CINNAMON TEAL.**

A single specimen of this species was taken by a hunter on Lake Koshkonong, October 18, 1879, and mounted by Thure Kumlien. An immature plumaged male was seen by L. K. in a hunter's string of ducks at Lake Koshkonong, October 9, 1891. The owner flatly refused to part with this bird for any consideration after he found it was not the common teal, although he had not noticed any difference before. There is no doubt but that this species occurs occasionally now. There are several more or less authentic records among well informed sportsmen in different parts of the state, and at club houses on Lake Koshkonong.

Spatula clypeata *(Linn.).* **SHOVELLER.**

This species does not seem to have decreased in numbers during the past thirty-five years to the same extent that most of the other ducks have. It is still a common duck, but can hardly be called abundant, as it does not occur in such great numbers as many others do. Arrives in southern Wisconsin about the first of April, and many remain until the ice closes the small lakes and streams in late fall, but it is most abundant during October. Essentially a duck of the large marshes and shallow lakes, in these localities considerable numbers still nest within the state, even to the most southern counties. It is exceedingly variable in plumage, and the males probably do not acquire the full dress until they are at least three years old. Anything like a complete series of the plumage changes of this bird would require not less than twenty or more individuals. A remarkable specimen was secured by L. K. in May, 1870, an adult female, just about to deposit eggs, with the breast and, in fact, all the lower parts from the neck down colored like a spring male; the wings also showed an approach to the color pattern of the male. Otherwise the plumage was as in the normal female. We have noticed a tendency this way on one or two occasions before with other ducks. A most excellent table bird.

Dafila acuta *(Linn.).* **PINTAIL.**

An abundant migrant. A few still nest within the state, but they are being gradually pushed farther and farther north for the summer season. This is one of the ducks that have slowly changed their habits, until now it can be classed as a winter resident in many localities in southern Wisconsin. Wherever there are extensive corn fields, not too far from open spring-brooks, these ducks remain all winter. The pintail is most numerous in March and early April in pond holes and on large fields, and again in October on the lakes and large marshes.

Aix sponsa *(Linn.).* **WOOD DUCK.**

Formerly a very common summer resident in all heavily wooded regions about streams. At the present time more common during the migrations, spring and fall, but in much smaller numbers than thirty years ago. Grundtvig (1) gave it as "by far the most common duck at Shiocton," Outagamie County, in 1882-83, breeding "abundantly in the old maples near the river." Considerable numbers still nest in favorable localities in the central and northern part of the state, and in a few places in southern Wisconsin, as about Delavan Lake. Mr. J. N. Clark writes us that it nests regularly in Dunn County. It arrives from the first of April to the first of May, and a few remain into November, but the greater number move southward after it begins to grow cold in October. In fall it resorts to the great wild rice marshes, and while the rice lasts that seems to be its principal food. Later it takes to the oak groves about the streams and lakes, and seems to be especially partial to the acorns of the burr oak. These it eats in large quantities. It often nests considerable distances from water. We know of one instance where it bred regularly for a number of years in a very large hickory. This tree was over two miles from the nearest water in a direct line. One of our most omnivorous ducks, and, contrary to the opinions of many people, should not rank very high as a table bird.

Aythya americana *(Eyt.).* **REDHEAD.**

Arrives in Wisconsin usually with the breaking up of the ice in the smaller lakes, and returns in numbers in October, remaining until the ice again forms. This and the following species show more partiality to certain localities than others of the genus. It has been greatly reduced in numbers of late years, more so than most ducks. Formerly very abundant, it is disappearing at an alarming rate. In the fall this duck is nearly, if not fully, equal to the canvas-back in flavor, and as it commands a high price in the market, is persistently and systematically hunted and shipped to the larger cities despite the law. Has been known to breed at Pewaukee (N. S. Goss) and in Brown County (C. F. Carr). Formerly bred at Lake Koshkonong, and even at the present day a few pairs nest annually in the large marshes about the lake. The principal food of this species in the localities where it resorts in numbers during the autumn is composed of the gemmæ or nutlets of one or more species of the pond-weed family, which is also the chief food of the canvas-back when it returns in the fall.

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1. On the Birds of Shiocton in Bovina, Outagamie County, Wisconsin, 1881-83. Translated by Chas. E. Faxon, Trans. Wis. Acad. Sci., Arts, and Let. X, p. 97-1895.

Aythya vallisneria *(Wils.)*. **CANVAS-BACK.**

Common migrant. Thirty to forty years ago this duck was supposed to remain only a few days in early spring and October in favored localities where the so-called "wild celery" grew in abundance. Such localities were apparently not numerous, and the species was rated as one of exceedingly irregular distribution. During the past twenty-five years it has become more universally distributed over the state, and locally, at least, not greatly diminished in numbers. We have known for a number of years that the so-called "celery buds" with which these and other ducks are actually crammed to the bill, was no part of the plant *Vallisneria spiralis*, but still we were unable to determine what it was. What little we do know in this connection is due principally to the careful observations of Mr. H. L. Skavlem, of Janesville. Mr. Skavlem took the "buds" from the œsophagus of freshly killed specimens of the canvas-back, and keeping them in water in the cellar through the winter, succeeded in growing the entire plant the next season. This plant proved to be one of the pond-weed family (*Naiadaceae*), of which there are numerous species in the northern states. These gemmæ, or nutlets comprise the great bulk of the food of this duck in October and November in Wisconsin. In shape they are spindle form, from one-half to one inch or more in length, of a whitish color and highly farinaceous. The pond-weed grows very luxuriantly in Lake Koshkonong and other waters of the state. Where the "celery" (*Vallisneria spiralis*) grows in abundance they no doubt eat parts of it, but this condition does not obtain in quantities sufficient to furnish food enough to tempt the ducks to remain. The unusually hot, dry summer of 1901 made the shallow water of Lake Koshkonong almost hot, and the pond-weed, as well as other aquatic plants suffered greatly, so that the nutlets were smaller than usual and much fewer in number. As a consequence the ducks remained a much shorter period than usual. It is our opinion, in which Mr. Skavlem concurs, that this particular pond-weed is found in greater abundance than formerly. It also grows in shallower water than the *Vallisneria*, often even inside the belt of rushes. There is not a shadow of doubt but that the bulk of the canvas-back's food consists of the nutlets of this plant at the present day, but has anyone noted any difference in the flavor of the flesh? A number of crippled birds remain on Lake Koshkonong through the summer, and we know of three instances of females being seen with nestlings, but incline to the opinion that the birds were winged and could not continue the journey northward. In December, 1877, some farmers who were digging the decayed vegetable matter, known locally as "muck," for fertilizer, exhumed in a small bay on Lake Koshkonong, a beautiful specimen in the condition known as adipocere. With the exception of the feathers, every part, even to the intestines, was perfectly preserved, and had the appearance of meerschaum. Several shot holes are plainly noticeable on the breast and abdomen, and one shot is imbedded in the sterum. The specimen is now in the collection of Milton College.

Aythya marila *(Linn.).* **SCAUP DUCK.**

Migrant. Of regular, but far from common occurrence on all the larger water courses of the state, frequenting most plentifully the deeper lakes and large rivers. Arrives earlier in spring and departs later in fall than either of the other "blue-bills." We have no evidence that leads us to suspect that this species ever breeds in the state. More common on Lake Michigan. We have seen large numbers of these birds, with a few of *affinis* and *collaris* in the Milwaukee market, all killed on the lake, and we suspect this is the common form which winters on Lake Michigan. More common inland in fall than spring.

Aythya affinis *(Eyt.).* **LESSER SCAUP DUCK.**

An exceedingly abundant migrant, both spring and fall. Probably the most abundant duck in Wisconsin, arriving with the breaking up of the ice and remaining in the fall until well into December, or until every lake is frozen over. To a limited extent a breeding species even in southern Wisconsin, having been known to nest anywhere from the southern counties northward, but as with most of our ducks and waders by far the great majority pass beyond our borders to nest. On every lake of any size, Winnebago, Koshkonong, Delavan, etc., numbers pass the summer in flocks on the open water. These are not breeding birds, however. Easily decoyed, consequently great numbers are annually killed, but the species seem to hold its own as to numbers better than most ducks. The true scaup ducks are more largely animal feeders (especially on *mollusca*) than the next.

Aythya collaris *(Donov.).* **RING-NECKED DUCK.**

Very common during spring and fall, and to some extent a summer resident. Thirty to forty years ago the ring-neck nested in numbers anywhere in the state, and even at the present day some few nest regularly as far south as Rock County, and more in the less settled sections. We think this species is still as abundant during the migrations as thirty years ago. A most excellent table bird; feeds largely in fall on the same food as does the canvas-back. Usually known to Wisconsin gunners as "black-head" or "ring-bill."

Clangula clangula americana *(Bonap.).* **AMERICAN GOLDEN-EYE.**

Common migrant and abundant winter resident wherever there is open water. Has apparently become a more common winter resident during the past fifty years. There are several breeding records for northern Wisconsin, and we have ourselves seen adult males at various northern points during the summer, but found no actual evidence of nesting. Fifty years ago this species was not considered as abundant as the next by Thure Kumlien in southern Wisconsin in winter. Three partial albinos have come under our notice, and one supposed hybid—*Clangula* x *Aythya.*

Clangula islandica *(Gmel.).* **BARROW'S GOLDEN-EYE.**

Actual records for the state are not many. Reported from Racine in 1860 by Dr. Hoy. One specimen was sent to Thure Kumlien from Edgerton in 1877, and one was shot by L. Kumlien November 14, 1896, on Lake Koshkonong. Large numbers of golden-eyes remain on Lake Michigan during winter, and no doubt this species is of regular occurrence with them. Many remain all winter also in open water at Neenah and Menasha, and at different places on Fox River, but as these birds have not, to our knowledge, been studied with any care, we do not know how often *islandica* may occur. No distinction is generally made by gunners, so ornithologists get but few records from this source, and furthermore the females and immature birds are very difficult to distinguish from *americana* by anyone. In a copy of Rev. Mr. Barry's list of 1854, although he does not include this form, we find pencil notes by Thure Kumlien as follows: "*Clangula vulgaris* (= *C. c. americana*) only one specimen taken; is here not as common as *C. barrowii* (= *islandica*) in winter, 1854."

Charitonetta albeola *(Linn.).* **BUFFLE-HEAD.**

Very common migrant in spring and fall, but greatly diminished in numbers of late years. Young still unable to fly have been shot on Pewaukee Lake by B. F. Goss, which is the only authentic breeding record for Wisconsin. Even this should be considered as exceptional. Immature birds are frequently taken in the larger inland lakes in summer, but are evidently not breeding. Universally known among Wisconsin hunters as "butterball."

Harelda hyemalis *(Linn.).* **OLD-SQUAW.**

Very abundant on Lake Michigan in winter. During the unusually severe winter of 1880-81 hundreds froze to death in the ice off Milwaukee, and boys peddled them, principally bones and feathers, about the streets at ten cents a dozen. Of late years becoming more and more common on the inland waters. Twenty-five years ago it was considered "quite a take" in the interior, and those found were usually young birds in October and November. Now they are anything but rare on most of the larger lakes, and are sometimes taken in numbers, even in spring, but we have never seen them in Wisconsin in breeding plumage. On the lake a few arrive early in October, and their numbers increase until well along in the winter. By March they become restless, soon begin to gather in immense flocks, are then very noisy, and are all gone by early in April, except possibly a few in immature plumage which remain until well along in the month. When one has seen and heard these ducks as they arrive at their northern breeding grounds in immense flocks, and congregate on the ice about the open water in May, he does not wonder that Sundevall should speak of them as "*Anas canora, ob cantum vernalem suavem et sonorum*," for heard at some little distance, with several hundred voices in concert, it ceases to be a jabber, and is really melodious.

Histrionicus histrionicus *(Linn.).* **HARLEQUIN DUCK.**

Rare winter straggler to Lake Michigan. Dr. Hoy obtained at least four specimens at Racine, and there is an old record, specimen not extant, however, for Milwaukee. Also reported from Lake Koshkonong, but on insufficient evidence, as is also the case with one other record for the state.

Somateria dresseri *Sharpe.* **AMERICAN EIDER.**

Lake Michigan in winter, rare. Recorded at Racine in winter of 1875, by Hoy. Two specimens were also taken at Milwaukee and were preserved in the Public Museum. The only positive record for the interior that we are aware of, is one specimen, a female, shot on Lake Koshkonong, in November, 1891.

Somateria spectabilis *(Linn.)*. **KING EIDER.**

Although this species occurs only as a rare winter resident on Lake Michigan, there are more authentic records than of the preceding. Has been taken at Racine and there is now a specimen in the Milwaukee Public Museum, taken at Milwaukee many years ago. In the collection of Dr. E. Copeland and H. Russel, of Milwaukee, are two specimens taken at that point, a male, January 7, 1900, and a female, December 25, 1899. There was, about 1874, at Madison, a mounted immature plumaged male, said to have been shot on Lake Mendota; and in 1880 we saw in a fisherman's house near Sheboygan, a mounted male of this species in nearly full plumage. This specimen was caught during the winter in a gill net. During our sojourn on the Great Lakes we are positive of having seen king eiders in small flocks several times in late fall. Being very familiar with the bird in the Arctic regions, we think there was no mistake.

Oidemia americana *Swains.* **AMERICAN SCOTER.**

Rather common winter resident on Lake Michigan. Less common in the interior, occurring principally as a migrant in late fall. Rarely met in full plumage. The three species of "surf ducks" are apparently becoming more common, especially the next two, in autumn.

Oidemia deglandi *Bonap.* **WHITE-WINGED SCOTER.**

Much more common in the interior than the preceding. Found on all the larger inland waters from October until the ice makes. At times exceedingly abundant on Lake Michigan, vast flocks being met, at long distances from land. It is often taken in the fishermen's nets in deep water far from shore. Like the other scoters seldom met in full plumage. Called "coot" and "velvet duck" by the gunners, few distinguishing this from the other species.

Oidemia perspicillata *(Linn.)*. **SURF SCOTER.**

Not rare on Lake Michigan in winter, and usually found on all the larger inland lakes in late fall. Seldom taken in the spring, most of the specimens being young or immature birds. For some unexplainable reason King's list of Wisconsin birds (1) does not even mention one of these three species of scoters as found in the state.

Erismatura jamaicensis *(Gmel.).* **RUDDY DUCK.**

Common migrant, but not nearly as abundant as formerly. Until within a few years this duck was considered almost worthless for food by most people, and, as a consequence, escaped systematic hunting, especially as it seldom decoys or flies past a blind. It has, however, suddenly sprung into favor among sportsmen and will soon be rare. A duck of peculiar habits, it is not well adapted to "hold its own" against the warfare now waged upon it. A rather late arrival in southern Wisconsin, it moves southward again as soon as the ice forms. A few breed in the state, as about Lake Koshkonong, Pewaukee Lake, Lake Horicon (Goss), etc., but sparingly of late.

Nomonyx dominicus *(Linn.).* **MASKED DUCK.**

Accidental. A single female was procured by Thure Kumlien on Rock River, near Newville, November, 1870, "and is now preserved in the collection of the Boston Society of Natural History" (2).

Chen hyperborea *(Pall.).* **LESSER SNOW GOOSE.**

Migrant. Snow geese were formerly very abundant during the spring and fall migrations in Wisconsin, but of late years have so diminished in numbers that at the present time they are almost rare. Both species occur, in about equal numbers, so that what is said of one, applies equally to the other. More often met along the Mississippi River than in the interior or on Lake Michigan, especially in the fall, of late years. A few flocks still regularly pass up the eastern half of the state in spring, but it is a mere fraction of the former numbers. Nearly always associated with *C. cœrulescens* and *A. a. gambeli.*

Chen hyperborea nivalis *(Forst.).* **GREATER SNOW GOOSE.**

Migrant, formerly abundant, now rather rare. We should say that possibly fifty per cent. of the snow geese taken in Wisconsin are intermediate between this variety and the last. Occasional flocks are seen passing high overhead, but of which form it is of course impossible to determine. Of the specimens examined, taken during the past sixty years and mostly when

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1. "Geology of Wis.," 1873-1879, Vol. I, p. 441-610.
2. North. Am. Birds, B., B. and R.

the birds were abundant, about one-half are typical of either *hyperborea* or *nivalis*, and in about equal numbers, and the balance intermediate. They feed sparingly now about the larger corn fields in southern Wisconsin, especially in spring, where they formerly resorted in large numbers.

Chen cærulescens *(Linn.)*. **BLUE GOOSE.**

Although by no means rare along the Mississippi, and in spring anywhere on the larger lakes and prairies, this species, as elsewhere, is none too well known in our state. It is of irregular and erratic occurrence in Wisconsin anywhere except along the Mississippi, and is usually found in the eastern counties associated with the snow or white-fronted goose, more often the latter. It is easily decoyed, and does not seem to have the ordinary "goose sense" of other species. We have it, in every stage of plumage, from Koshkonong and Delavan Lakes and the surrounding prairies. The "bald brant," as many sportsmen call the adult of this species, is usually an early spring migrant, sometimes arriving the latter part of February, but commonly in March. One specimen taken on Delavan Lake as late as April 18.

Anser albifrons gambeli *(Hartl.)*. **AMERICAN WHITE-FRONTED GOOSE.**

Formerly an exceedingly abundant spring and fall migrant, but of late years not at all plenty. Frequents the large prairie corn fields. This species has been credited by some as a summer resident, but it is extremely unlikely that it ever breeds in the state. Specimens have sometimes been taken as late as the middle of May, but there is no evidence that they were breeding, and individuals have been known to remain all summer in the flocks of tame geese on Lake Koshkonong. Commonly known as "brant," or "speckle-belly" among the Wisconsin gunners.

Branta canadensis *(Linn.)*. **CANADA GOOSE.**

Abundant, increasing rather than diminishing in numbers, during the fall, winter and spring. To such an extent has this species changed its habits that it is no longer looked upon as a sure harbinger of spring, as in most sections of southern and even south-central Wisconsin it remains all winter, flying back and forth from its favorite corn fields to some lake or large marsh for the night. When snow is plenty it even remains in the fields for days at a time. Twenty-five to fifty years ago the flocks which first made their appearance were noted by every one, and spring was not far distant. Now the flocks which return from the north in October are continually added to until they are often several hundred strong, and remain thus until the beginning of spring. Of late years the standing corn is cut with a machine, which not only cuts the corn but the weeds also, and this gives the geese a clear view of the surrounding country, which is one thing they must have in order to feed contented. Fifty years ago a common breeder in almost any swamp or large marsh, or on the "prairie sloughs" (now a feature of the past). At the present time only scattered pairs nest as far south as the southern third of the state. The last nesting record we have for southern Wisconsin was in Jefferson County—from the years 1891-99, inclusive, when a goose deposited her eggs on the edge of a tamarack swamp, on the same mound of rubbish each year. The first set was taken several times, when she moved to another mound farther into the swamp and here hatched her eggs. No mate was ever noticed to have visited her.

Branta canadensis hutchinsii *(Rich.)*. **HUTCHINS'S GOOSE.**

Typical ***hutchinsii*** is by no means rare in Wisconsin, especially in late fall and winter. A serious problem, however, confronts us when we attempt to draw the line between this and the foregoing variety, as every stage of difference between the two is represented by the hundreds of intermediates.

Branta canadensis minima *(Ridgw.)*. **CACKLING GOOSE.**

Credited to the fauna of Wisconsin in Ridgway's "Manual of North American Birds," the "A. O. U. Check List," and other works, as a straggling migrant. A small goose with short neck, minimum amount of black, dark underparts and distinct white crescent at the forward lower part of black neck marking is of frequent occurrence in Wisconsin, sometimes in large flocks made up of this kind entirely, and again in company with geese of every varying degree of size and marking. Specimens of this character have been examined of barely six pounds weight, and in the collection of Mr. Skavlem is a specimen weighing five and one-half pounds, which we think could be called typical *minima*. These birds are locally known as "bull-necks" by the sportsmen. As with the case of ***hutchinsii***, compared with ***canadensis***, there are also intermediates of every varying degree between this form and both the others. There are occasionally large geese with dark underparts, slender necks and a distinct collar of white on lower neck. The white cheek patches appear to be indifferently separated by black on throat, or unbroken, among geese of all sizes, shape and coloration. We have examined carefully many dozens of fresh specimens killed at all times from early fall until late spring, and frankly admit our inability to satisfactorily unravel the "goose question" in Wisconsin. It is very likely that we have in winter these three varieties, and possibly four, with, as stated, every varying degree among the many intermediates.

Branta bernicla glaucogastra *(Brehm.)*. **WHITE-BELLIED BRANT.**

The brant has been listed as a bird of Wisconsin for a great many years, but when all records are sifted, we have left as authentic only the one of Dr. Hoy — a single specimen taken at Racine many years ago. This was one of three from the shore of Lake Michigan. For the past thirty years we have run down "brant" records innumerable — to find that in every case it proved to be something else, varying from the common Canada goose to a female eider duck! So persistently have we followed this up that we have come to the reasonable conclusion that this sole authentic record is merely accidental. We shall have no faith in any Wisconsin brant record unless accompanied by the brant itself. All of the smaller geese are universally called "brant," which makes it impossible to even consider a record except with suspicion. In the "Report of Bird Migration in the Mississippi Valley, 1884 and '85," by W. W. Cooke, we find statements that would indicate that this species, at least in 1883-4, was noted in Illinois, and that in Minnesota it became almost common. Prof. Cooke himself seems to question these records; and if they were obtained from no more reliable sources than ***some*** of the Wisconsin records were, they are absolutely worthless as proving the occurrence of the brant in the Mississippi Valley. Barry's list of 1854 says, "abundant in all parts of the State, and large numbers breed here." This is, of course, utterly false. Unfortunately the Hoy collection, now in the possession of Mrs. Wm. Henry Miller, of Racine, is left entirely without labels, and the records, or catalogues, have been lost or destroyed. The single brant preserved there is, without question, the specimen taken at Racine and is a perfectly typical *glaucogastra*.

Olor columbianus *(Ord.).* **WHISTLING SWAN.**

Migrant. During late fall, just before the larger lakes freeze over, this species is not at all rare in suitable localities. In the spring it is less regular, being much more numerous some years than others. Large numbers yearly visit Lake Koshkonong, and they are of regular occurrence at Delavan Lake, sometimes in goodly flocks. On Koshkonong they sometimes remain as late as May 1. Not commonly found on Lake Michigan, often common along the Mississippi, but probably more abundant in the Rock River Valley than in other parts of the state. April 2, 1896, four specimens were procured from a large flock on Lake Koshkonong. Two of these were full plumaged birds, perfectly white with black feet and bills, the latter with the usual yellow spots. One younger (?) specimen had the bill clouded and blotched with pink, and the toes and *tarsi* somewhat mottled. The fourth had a plain pink bill, with no spots, and *tarsi* and toes milk white. Two of these are in the Hollister collection and two in the Kumlien collection. We are somewhat at a loss to account for the color of the bills and feet in two of the specimens, as, if characteristic of the young, all the young should show it; but we have procured a good many of the young (of the year?) in fall, and although many were in the dark plumage, *all* had black bills and feet. One other specimen in the Kumlien collection, killed in October, is of a uniform dingy ash color, with typical feet and bill, yellow spot included. Very variable in size also, some specimens fully as large as the next. The Kumlien collection contains a specimen which measured sixty-two inches in length.

Olor buccinator *(Rich.).* **TRUMPETER SWAN.**

At the present day the trumpeter swan is surely a very rare bird in Wisconsin, and it is not certain that it could, at any time during the past sixty years, have been called common. In the early forties "swan" were reported as nesting in southern Wisconsin (Dane and Jefferson Counties), and if this is true it was no doubt this species. Thure Kumlien had a juvenile specimen obtained somewhere between 1842-45 in Jefferson County, with down on the head and primaries still soft, color a dingy ash. This specimen was still in existence in 1900, and doubtless is yet. During the fall of 1857 a large flock alighted on the prairie east of Stoughton during a heavy snowstorm, was seen by some farmers, who reported the birds as unable to fly on account of the heavy snow and sleet, and over twenty were killed. Six of these were procured by Thure Kumlien and preserved. In the past fifteen years we have handled but two specimens. One was mounted for a hunter, who procured it from a flock of three on Lake Koshkonong May 6, 1893! This specimen contained *ova* the size of an ounce leaden bullet. A very large, fine male was also killed by L. K. on Rock River in March, 1892. Doubtless it occurs more frequently along the Mississippi River than in other parts of the state.

ORDER HERODIONES: HERONS, STORKS, IBISES, ETC.

FAMILY PLATALEIDÆ: SPOONBILLS.

Ajaia ajaja *(Linn).* **ROSEATE SPOONBILL.**

By reference to Rev. A. C. Barry's list of 1854 we find the following regarding this species: "Found along the Mississippi within the bounds of our state, and occasionally about our small lakes in the interior." The sole actual and positively authentic record, however, entitling the spoonbill to a place in the present list, is from the fragments, head, wing and leg, of a specimen procured by Indians at Indian Ford, on Rock River near Janesville in August, 1845, and preserved by Thure Kumlien. These remains are still extant in the Kumlien collection. Several early references to the peculiar red birds taken or seen in southern Wisconsin no doubt refer to this species, but are not authentic. When the bird was common and ranged north to southern Illinois, it doubtless wandered at times, after the breeding season in late summer, to our southern limits, as is the case with other species of *Herodiones.*

FAMILY IBIDIDÆ: IBISES.

Plegadis autumnalis *(Hasselq.).* **GLOSSY IBIS.**

Rare straggler, usually in late summer. In August, 1862, a collector employed by Thure Kumlien shot one of these birds on a large mud flat on Lake Koshkonong. The bird fell in tall grass in miry soil and he did not succeed in finding it. His description of the bird aroused Mr. Kumlien's curiosity, and the next day a more extended search was made, which resulted in the specimen being found, in such a state, however, that only enough was preserved for identification. In September, 1872, T. and L. Kumlien saw seven on a large mud flat near Black Hawk Island, Lake Koshkonong, but did not succeed in getting within range. A specimen was shot on Lake Horicon (now Horicon Marsh) November 3, 1879, and is preserved in the Milwaukee Public Museum. We have positively seen this bird on the Mississippi near Prairie du Chien in August, some twenty years ago.

FAMILY CICONIIDÆ: STORKS AND WOOD IBISES.

Tantalus loculator *Linn.* **WOOD IBIS.**

There are recorded several captures of this southern species within the state. Can be classed only as a very rare midsummer straggler at the present day, however. It is, or was, supposed to ascend the Mississippi in July and August quite regularly, on hearsay evidence alone. Rev. A. C. Barry in 1854 refers to a specimen shot at Milwaukee "a year or two since," which may be the same specimen referred to by Dr. Hoy in 1852, as "in the Museum of the Wisconsin State Historical Society at Madison, which was shot near Milwaukee, September, 1852." We were informed, however, that the specimen in Madison was shot on the Mississippi at La Crosse in 1852, and the Milwaukee specimen was preserved in the Museum of the old Natural History Society there. Dr. Hoy also procured a specimen at Racine in September, 1868 (1). A specimen was mounted by S. Sercomb at an early date, killed on Rock River, between Janesville and Edgerton. This specimen was seen and examined by Thure Kumlien, but as it was the property of a private individual, we do not know if it is still in existence.

FAMILY ARDEIDÆ: HERONS, BITTERNS, ETC.

Botaurus lentiginosus *(Montag.).* **AMERICAN BITTERN.**

Common summer resident in all suitable localities from the southern tier of counties northward, but most numerous in the southern third of the state. A few remain in the fall until severe weather sets in, sometimes even into November. The idiotic practice of so-called "sportsmen" invariably to kill these

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1. Letter from Dr. Hoy to L. Kumlien. Nelson, Birds N. E. Ill., gives the date as 1869.

birds as they are flushed from the grass and along the shores of lakes has gradually reduced their numbers until they are not nearly as numerous as formerly. We have reared the young from the nest and kept them through the winter, and we only regret that Elliott Coues did not have our experience with them to add to his incomparable article on the life history of the species in his "Birds of the Northwest."

Ardetta exilis *(Gmel.)*. **LEAST BITTERN.**

Very abundant summer resident on all reedy swamps and lakes. This delicate little bittern, apparently so weak that it is a wonder it holds its own as it seems to do, does not remain after severe frosts in the autumn. A common breeding species, depositing its five to seven eggs (not three or four as often stated) on its frail nest among the tall rushes. A summer resident even to the shores of Lake Superior, but much more common in the southern counties.

Ardetta neoxena *Cory.* **CORY'S LEAST BITTERN.**

In June, 1845, Thure Kumlien found some Indian children playing with a small headless heron, using it as a target for bow and arrow practice. This was at an Indian encampment on Black Hawk Island, Lake Koshkonong. The bird was new to him and he secured it and later sent a color sketch to Dr. T. M. Brewer. Brewer pronounced it probably some southern species or a different plumage of the least bittern. A copy, or in fact the original sketch, is still in our possession, and it plainly shows the specimen to have been a typical *Ardetta neoxena*. No others were found and the matter was lost sight of by both Dr. Brewer and Kumlien. Neither was the bird ever found by L. Kumlien during many years of careful marsh collecting in the same locality. Its claim to a place in the present list, therefore, rests principally on the capture of a full plumaged male by Mr. C. E. Akeley on Lake Koshkonong, May 22, 1893, and preserved in the Field Columbian Museum, Chicago (1).

Ardea herodias *Linn.* **GREAT BLUE HERON.**

Rather common spring migrant. Nests in communities in different sections of the state, less frequently of late years than formerly, however. Breeding rookeries are found usually in large tamarack swamps, but at times in second-growth oak. Breeds from the southern tier of counties northward. The largest rookery we have ever visited was a short distance west

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1. Cherrie, Auk, XIII, p. 79.

of Two Rivers. Others are, or have been, at Fox Lake, Stevens Point, Waukesha, Barron County and other points; also, frequently, scattering pairs are found among the colonies of night herons or even singly. By the middle of August the young begin to spread over all sections of the state, and "blue cranes" are then abundant until fall.

Ardea egretta *Gmel.* **AMERICAN EGRET.**

Twenty-five to fifty years ago the egret was a common bird on the larger marshes and swamps bordering the inland lakes and rivers. Of late years, thanks to the barbarous plume hunters, rare, so rare at the present time that three or four individuals only visit Lake Koshkonong each year where hundreds were found thirty years ago during August and September. A few single birds or small flocks rarely visit Delavan Lake during the early fall. Fifty years ago specimens were occasionally taken on Koshkonong in June, but were never found nesting. Young, unable to fly, were taken from a colony in a tamarack swamp near Jefferson in July, 1863. It was found breeding with a large colony of great blue herons to the westward of Two Rivers in June, 1880. Also reported as nesting near Waukesha in 1866.

Ardea candidissima *Gmel.* **SNOWY HERON.**

A rare and irregular visitor from the south during August and September. Has been procured on Lake Koshkonong from time to time for the past sixty years, but usually only one or two at a time, from the large flights of *egretta* which formerly visited the lake. The only adult bird in early summer that we have ever known in the State was taken on Koshkonong in June, 1860, and is preserved in the Kumlien collection. In August, 1886, Mr. H. L. Skavlem shot six of these birds from a flock of egrets, also on Lake Koshkonong. This is the last authentic record of any numbers that we know of. Of late years very rare. We have never been able to trace a capture of the snowy heron north of Milwaukee, Madison and La Crosse. Dr. Hoy's note on this species as a common bird, "nesting in communities in tamarack swamps," refers to the preceding species, or possibly the night heron, and was a conclusion formed by finding the snowy herons in the swamps in August, and even July, not knowing of their habit of northward migration in late summer.

Ardea cærulea *Linn.* **LITTLE BLUE HERON.**

Rare accidental straggler. A single individual was shot on Root River, Racine County, August 28, 1848, by Dr. P. R.

Hoy. A single wing of a decomposed specimen was preserved by Thure Kumlien. This was found on the shores of Lake Koshkonong in the early fifties. Both of these were young birds in the white plumage, and no doubt straggled northward with other young herons. These, we believe, are the only authentic records for the species in Wisconsin, and can only be considered as purely accidental.

Ardea virescens *Linn.* **GREEN HERON.**

Common summer resident. Does not nest in colonies, but usually in scattered pairs, sometimes two or three together in a favorable place along some wooded stream or pond. Found as far north as the shores of Lake Superior at least. Somewhat diminished in numbers of late.

Nycticorax nycticorax nævius *(Bodd.).* **BLACK-CROWNED NIGHT HERON.**

Common summer resident. Always somewhat erratic in distribution, sometimes frequenting only the thickest and most retired woods and swamps, and to a considerable extent nocturnal, or rather crepuscular in habits, it is easy to get a wrong impression of its numbers, and many people never suspect its presence. There is also no doubt that the night heron is much more numerous in Wisconsin than formerly. Large colonies, or breeding rookeries, have been located to our knowledge at Lake Koshkonong, Albion, Stoughton, Fox Lake and Delavan, as well as in many other localities. Seems to nest indifferently in trees or on the ground in marshes. The marsh nests that we have examined have always been placed among the cane (*Phragmites phragmites*), and not the wild rice, as stated by Nelson and others.

ORDER PALUDICOLÆ: CRANES, RAILS, ETC.

FAMILY GRUIDÆ: CRANES.

Grus americana *(Linn.).* **WHOOPING CRANE.**

Formerly of regular occurrence in the southern and western part of the state during migrations, unquestionably breeding to some extent. Thirty or forty years ago it was not rare to see a few among the enormous flocks of sandhill cranes during the October migrations, and even flocks composed entirely of this species. Of late years adults are exceedingly rare, and the last record we have of a Wisconsin capture was in October, 1878, when a fine old bird was shot in Green County and sent to Thure Kumlien. Even as long ago as 1840 they were rare along Lake Michigan, while they occurred in numbers along the Mississippi River and the west central part of the state. Among the flights of the common crane that often remain upon the larger dry marshes for two weeks or more in October, there are noticed a few large "yellowish" specimens that are presumably the young of the year of the whooping crane, but they are so shy that approach is practically impossible. Newspaper and other reports of flocks of "white cranes" and of specimens shot in various parts of the state of late years, refer to the american egret, and not to this species.

Grus canadensis *(Linn.).* **LITTLE BROWN CRANE.**

Rare straggler during early spring and late fall. During the latter part of March and the first part of April, 1894, a lone crane kept with a flock of Canada geese on Rock Prairie, near Johnstown, Rock County, for some days, and appeared to act as chief sentinel while the geese fed in the fields, always flying away with the geese when alarmed. This bird was killed on April 4 (1894) by L. Kumlien, and proved to be a fine plumaged male of this species—and very small. It is now preserved in the Museum of the Whitewater Normal School. At least one other, that we are positive of, was shot in Dane County late in the fall of 1879, and came into the possession of Thure Kumlien frozen stiff. This specimen was formerly in the Museum of Albion Academy.

Grus mexicana *(Müll.).* **SANDHILL CRANE.**

In an early day a very abundant migrant and common summer resident, from the southern border of the state northward. Although at the present time entirely absent from most thickly settled portions of the State, there are still many localities, even in southern Wisconsin, where it occurs regularly in good numbers. On the "Big Marsh" near Delavan cranes occur every spring and fall in numbers from one hundred to two hundred and fifty, remaining for nearly three weeks at a time. A nest of two eggs was procured on this marsh May 30, 1883. One of the eggs is preserved in the Hollister collection, the other having been broken. They were reported as nesting on the immense marsh near Palmyra, in 1898, and a few certainly bred near Mauston in 1896. The last authentic record for nesting in southeastern Wisconsin was of two pair which bred near Jefferson in 1900. There are also nesting records for Marquette and Plover during the past ten years, and unquestionably in many other places unknown to us. We have seen numbers of nests, but never noted one built up like a flamingo's nest as described by Dr. Hoy in 1852, although this might have been necessary in a very wet locality. So wary are these birds that of all that occur on the Delavan Marsh yearly we have known of but two being killed at this place in many years.

FAMILY RALLIDÆ: RAILS, GALLINULES, AND COOTS.

Rallus elegans *Aud.* **KING RAIL.**

Summer resident, much commoner than twenty-five years ago. A regular breeder in suitable localities throughout the state, but far less plenty west of the Rock River Valley than east of it. The value of this bird for table purposes has come to be recognized in many sections, and it is regularly hunted with a dog. Occurs in much higher and drier situations than any of the other rails, and often frequents stubble fields when not too far away from the marsh. We have found the œsophagus literally crammed with oats, and in the latter part of the summer and early fall the birds subsist largely on grasshoppers.

Rallus virginianus *Linn.* **VIRGINIA RAIL.**

Rather common summer resident, but in no such numbers as the next. To be found almost anywhere in low swampy land and, except when it first arrives, in late April, keeps well under cover unless flushed. There is no question that this species has become more abundant than formerly in southern Wisconsin. The Virginia rail possesses the power of ventriloquism to an extraordinary degree, and its note is also exceedingly variable. A specimen kept alive in a wire netting enclosure in a large spring one summer taught us that there was hardly any note or noise commonly heard in the marshes that he could not imitate, so wonderful were his powers of mimicry. Nests in rather higher situations than the sora.

Porzana carolina *(Linn.).* **SORA.**

A very abundant summer resident. Breeds in suitable localities over the entire state. Arrives in spring from May 1 to 10, and moves southward after the first sharp frost, although belated individuals are sometimes found well into November. Formerly not molested by gunners, but has gradually come to be considered a game bird and large numbers are shot in the wild rice marshes from the first to the middle of September. Large numbers of their nests are destroyed by the rising of the water on their breeding grounds, and many of the migrating birds are killed by flying into buildings and wires; but with all this destruction the little sora seems to hold its own in numbers in a wonderful way.

Porzana noveboracensis *(Gmel.).* **YELLOW RAIL.**

Summer resident. This little rail is not nearly so rare as generally supposed, though by no means common. We have authentic records from Racine, Milwaukee, Elm Grove, Delavan, Janesville, Milton, etc., and even breeding records as far north as Brown County. There appears to be no record for the western part of the state, but this does not necessarily imply that the bird does not occur there. The note of this rail is not generally recognized by observers and owing to its retiring habits and the difficulty usually experienced in flushing it from the grass it is very seldom seen.

Porzana jamaicensis *(Gmel.).* **BLACK RAIL.**

Although Mr. Nelson (1) found this species breeding in northeastern Illinois and considered it of not very rare occurence, it seems to have almost entirely escaped the Wisconsin ornithologists as yet. In fact, the only record we are aware of is the following: August 20, 1877 (2), a marsh hawk was killed by Frithiof Kumlien from a muskrat house on the border of Lake Koshkonong. When noted first it was eating something, and this proved to be a little black rail. We are quite sure of having seen it on one occasion, but the above is probably the only authentic record for the state as yet.

Ionornis martinica *(Linn.).* **PURPLE GALLINULE.**

Exceedingly rare straggler from the south. Most of the records obtainable are far from satisfactory, but the bird is without question entitled to a place in the Wisconsin list. Barry's list of 1854 says "a few breed here every season" (Racine); but inasmuch as the same list does not mention the following species we are inclined to think a mistake has

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1. Birds of N. E. Ill., p. 134, 1877.
2. Possibly 1879, the last figure is badly blurred.

been made, especially as Dr. Hoy's list of 1852, from the same locality, does not include it. Dr. Hoy procured it later, however, at Racine, and we once handled a specimen said to have been shot north of Milwaukee, about 1860. One other specimen was also sent to Thure Kumlien in a decomposed condition at an early day, some time in the fifties. This specimen was killed near Janesville, and there can be no doubt as to its authenticity. There are also two or more other records about which there is suspicion. We once purchased a specimen labeled "Wis.," but could trace it no farther, and believe the locality may possibly have been substituted to suit the occasion.

Gallinula galeata *(Licht.).* **FLORIDA GALLINULE.**

A common summer resident as far as the north central portion of the state, and in less numbers to the shore of Lake Superior. Has apparently increased in numbers during the past thirty years, at least locally. We have reared the young of this species and the next a number of times, setting the eggs under a hen and feeding the chicks on baked cake, composed of cornmeal, oatmeal, bran and beef. An excellent table bird, and a very interesting species whose life history we think is but imperfectly known, and worthy of the closest investigation. We have found as high as seventeen eggs in one nest, although ten to fourteen is the common number. As soon as the first eggs are deposited incubation begins, the sun doing the work by day and the female parent by night. The first hatched young are thus two weeks old ofttimes before the last egg is hatched. The young as fast as hatched are cared for by the male, but are to a certain extent competent to care for themselves very soon. A ventriloquist of extraordinary powers.

Fulica americana *Gmel.* **AMERICAN COOT.**

Very abundant spring and fall migrant on all the lakes and larger rivers. A breeding species in considerable numbers anywhere in the state, but by far the greater number pass beyond our borders to nest. Nests in similar localities to the preceding, but is otherwise very different in its habits, the coot frequenting open water like a duck, while the gallinule, rail-like, seeks the cover of grass or rushes. Arrives early and remains until the lakes freeze over. Apparently has not decreased in numbers during the past thirty years. This bird is very liable to become bewildered during its nocturnal migrations and is often found in cities and about the outbuildings of farms a long distance from water. Known to most of our gunners as the "mud-hen" or "pull-do" (1).

ORDER LIMICOLÆ: SHORE BIRDS.

FAMILY PHALAROPODIDÆ: PHALAROPES.

Crymophilus fulicarius *(Linn.)* **RED PHALAROPE.**

Small flocks may be met on Lake Michigan and Lake Superior in autumn, and occasionally straggling individuals wander to the larger inland lakes. Four specimens, one adult female and three young of the year were taken on Lake Koshkonong September 3, 1891. We have but a single state record for the early part of the season, a solitary female killed by Thure Kumlien on Lake Koshkonong June 4, 1877. This bird was only just beginning to show the red summer plumage and there was nothing to indicate that it would have bred that season. We have seen flocks of waders on Lake Superior in October that were no doubt this species, but stormy weather and distance prevented positive identification. We know of no other wader, however, except the next, that would light on the icy waters of Lake Superior many miles from land in late autumn. Our acquaintance with this species in the arctic regions makes us feel sure of the identification; and Dr. Hoy notes it from off Racine in November, 1847.

Phalaropus lobatus *(Linn.).* **NORTHERN PHALAROPE.**

Much more common than the red phalarope. Noted on Lake Michigan and Lake Superior in September and October, and a regular spring and fall migrant on Lake Koshkonong, though more often taken in fall than spring. Frequently taken on Lake Koshkonong in August, and once as early as August 3 (1873). Often found in the open water of the larger lakes swimming with the coots far from shore. Birds in breeding plumage are rare in Wisconsin; even such as are procured in May and June are still principally in the winter dress. Twenty-five years ago it was no uncommon occurrence to have a flock of half a dozen or more light among the duck hunters' decoys

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1. A corruption of the French *poule d'eau* (water hen), as the bird is called in Louisiana. Trumbull, Names and Portraits of Birds," New York, 1888, p. 117.

on Koshkonong. Even when feeding with other waders along the shore it will be most often found outside the shore line, where it must swim instead of wade in order to feed.

Steganopus tricolor *(Vieill.).* **WILSON'S PHALAROPE.**

This, the most beautiful of all our waders, is a common summer resident in Wisconsin, breeding in larger or smaller colonies in many different parts of the state. Such breeding colonies are found near Pewaukee, at three different places near Lake Koshkonong, at Albion, Whitewater, Packwaukee and Green Bay, and, in fact, at any suitable place. One colony at Lake Koshkonong has been known to have more than two hundred pairs on the marsh at one time. Arrives in southern Wisconsin in full breeding plumage. At some localities in the state the bird appears to be a rather rare migrant only.

FAMILY RECURVIROSTRIDÆ: AVOCETS AND STILTS.

Recurvirostra americana *Gmel.* **AMERICAN AVOCET.**

Specimens of this peculiar wader were taken by Thure Kumlien at different times from 1844 to 1875. Three were shot on Lake Koshkonong September, 1873. Bred in Green Bay in 1879, where downy young were seen in the possession of a taxidermist by L. Kumlien. Those taken by Thure Kumlien were more often taken in September and October, and were principally young birds. A specimen in the Milwaukee Public Museum is labeled "Wis." At the present time it must be considered as exceptionally rare.

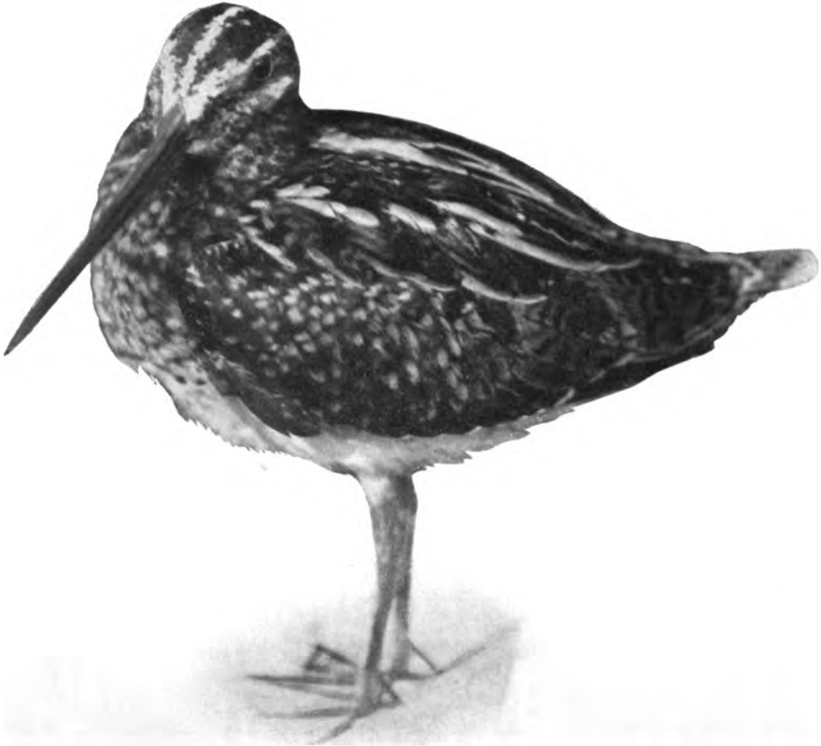
Himantopus mexicanus *Müll.* **BLACK-NECKED STILT.**

Very rare straggler. As far as we are aware the only record of this species for the state is that of Dr. Hoy, who states that "he met a small flock of these singular birds near Racine, April, 1847." The single specimen preserved in his collection was probably taken at this time.

FAMILY SCOLOPACIDÆ: SNIPES, SANDPIPERS, ETC.

Philohela minor *(Gmel.).* **AMERICAN WOODCOCK.**

Summer resident. Rapidly diminishing in numbers, though not an uncommon bird in suitable localities throughout the state. On the evidence of Thure Kumlien, Dr. Hoy, and others this species increased from the early forties up to



WILSON'S SNIPE.

Photo. from Life by F. E BURROWS.

say about 1870. From that time on to the present its numbers have decreased, from too close shooting, settlement of the country, and the draining and drying up of its natural resorts. An early breeder in bottom lands along streams, the eggs sometimes found in April. In fall remains until we have had very sharp frosts.

Gallinago delicata *(Ord.).* **WILSON'S SNIPE.**

Still a common species in most parts of the state—we might say abundant if it were not that we should be at a loss to express its numbers in former years. Arrives in southern Wisconsin early in April, and a large portion have passed north before May 1. A goodly number nest within the state as yet, even in the southern part. We procured two sets of eggs at Lake Koshkonong in May, 1891, and one set May 20, 1893, and were it not for the fact that the nest *can not* be discovered unless one flushes the bird, a good many might still be found. Mr. S. R. Hartwell, of Milwaukee, writes that it is still found to some extent in Waukesha County in summer, but that the nest is rarely found. He obtained a set of four eggs May 30, 1890, near Waukesha. Thirty-five years ago a nest was no rarity at all. By September 1 it begins to return from the north, yet unless there have been sharp frosts it is not very plenty until October, and it remains until well into November. A few are always found about open spring holes all winter. Of late so persistently hunted that it has materially decreased in numbers, even during the past ten years or less.

Macrorhamphus griseus *(Gmel.).* **DOWITCHER.**

Formerly a common migrant, now exceedingly rare. We have but one specimen of this form of the dowitcher in our collections, from Lake Koshkonong, although hundreds were formerly killed. There are, in the Milwaukee Public Museum, two specimens, these also from Koshkonong, taken in August, 1886. See remarks under next species.

Macrorhamphus scolopaceus *(Say).* **LONG-BILLED DOWITCHER.**

In order to rightly understand the following it is necessary to have some knowledge of the conditions as they existed in southern Wisconsin, and especially about Lake Koshkonong, from about 1865 to 1875. In the first place the shore birds, with the exception of the woodcock, and to a limited extent the jack snipe, were undisturbed by the gunners. No one thought of shooting them in the spring, and the consequence was that thousands upon thousands gathered upon the mud flats and remained for much longer periods than now. At this time also we recognized no specific difference between *scolopaceus* and *griseus*, for although we were well aware of a difference, especially in the length of the bill, there was every intermediate degree in measurements between the larger and smaller in this respect, and we had not classed them as distinct species. Consequently, these remarks must unfortunately apply to both species, as at this day we are utterly at a loss to say which species predominated, though we think *scolopaceus* did. Our collection to-day contains but one of each species, so that this is no guide whatever. As to the numbers of dowitchers that frequented Lake Koshkonong thirty to thirty-five years ago, during May, June, July, August and September, we forbear to attempt an estimate, as the younger generation would set it down as fabulous. Common as they were, often through July, but always less in this month than any other from May to October, but *very* few bred. Young still unable or barely able to fly were taken on several occasions. There is positively no question that considerable numbers bred in Wisconsin from 1865 to 1875 and in 1872 and 1873 as far south as Lake Koshkonong. In August the fully fledged young returned from the north in great flocks. The dowitchers were probably never as plenty on Lake Michigan as along the Rock River Valley. We incline to this opinion because Dr. Hoy did not find them in any numbers along the lake, and when he saw the flocks during a visit to Lake Koshkonong in June, his exclamations and gesticulations can only be imagined by those who were favored with his acquaintance. Nelson speaks of them only as a "rather common migrant" in northeastern Illinois in 1876. In Wisconsin at the present time they are known only during migrations and then sparingly. A few appear in May and June, and a very few at that, and again in August and September, but so irregularly that they may pass as rare. We have here a good illustration of what continual spring shooting can accomplish. For years the dowitchers were shot over decoys on Lake Koshkonong for the Chicago market, in May and the first half of June, until they have been practically exterminated. We are informed that from 1877 to 1880 two men averaged ten dozen a day during May and June!

Micropalama himantopus *(Bonap.).* **STILT SANDPIPER.**

Migrant and doubtless a former summer breeder to a limited extent. Of rather irregular occurrence, sometimes rare and again in such numbers that a dozen might be killed at a single shot. We have never seen them along Lake Michigan and they were almost unknown to Hoy. No doubt the greater number pass up the Mississippi, a considerable number branching off and passing up the Rock River Valley, and finding a place like Lake Koshkonong, just suited to their tastes, remain there longer than elsewhere. During the seventies they were rather common about Koshkonong, especially during the latter part of July, August and well into September. We have taken young barely able to fly, readily running them down; these had the head and upper neck still in the natal down, and if they were not hatched at Lake Koshkonong, certainly they could have come but a short distance. But few are taken in full breeding plumage, and at the present day they are decidedly rare in spring. Mr. J. N. Clark has taken the stilt sandpiper in Dunn County, three or four specimens in August and September, 1896; and Mr. W. E. Snyder reports a single capture at Beaver Dam.

Tringa canutus *Linn.* **KNOT.**

Thirty years ago a rather common migrant in May and June, and more sparingly in autumn. Of late years decidedly rare at any season. When common it was often taken in full breeding plumage. We have several times, especially in 1872 and 1873, the famous snipe years at Lake Koshkonong, taken knots in June and July, but there was no evidence that they were nesting, and if we are not mistaken they have been taken in mid-summer in Louisiana. Rarer on Lake Michigan, where we have seen small flocks in May several times in 1881-83.

Tringa maritima *Brünn.* **PURPLE SANDPIPER.**

Rare migrant. Dr Hoy states in his list of 1852 that this species was "greatly abundant" at Racine, from April 15 to May 20. As far as our personal observation goes we are inclined to think that the bird occurs only as an exceedingly rare straggler, at least at the present day. We have never seen, much less procured, one in the state. In the collection of the Oshkosh Normal School is a specimen which was said to have been taken at Bay View (Door County) in May, 1881.

Tringa maculata *Vieill.* **PECTORAL SANDPIPER.**

Twenty-five years ago an exceedingly abundant migrant during May, September and October. Of late, thanks to spring snipe shooting, the bird has decreased in numbers until now it is hardly common. Nelson speaks of a few remaining through the summer in northeastern Illinois (1877), and a few formerly spent the entire summer about the Koshkonong marshes, but there was never any evidence of breeding. At an early day, probably some time in the fifties, Thure Kumlien sent June skins to John Cassin, of Philadelphia, and Cassin, supposing it sufficient evidence that the pectoral sandpiper bred in Wisconsin, published a statement to this effect, on no other evidence, however, than the date when the birds were shot. It has been stated by different authorities that the bird breeds in Wisconsin, but no doubt they can all be traced to Cassin's premature conclusions. More numerous in the interior than on Lake Michigan.

Tringa fuscicollis *Vieill.* **WHITE-RUMPED SANDPIPER.**

Of regular occurrence at about the same time as the next, but by no means an abundant species. The white-rumps are in fine breeding plumage by the first week in June, and the females then contain *ova* the size of large peas. Small flocks of a dozen or less are sometimes found about Lake Koshkonong until the middle of June, and they are back again with barely full fledged young by August 1. It thus stands to reason that some of them, at least, can not go far north to nest. We have no evidence, however, that they ever breed in Wisconsin.

Tringa bairdii *(Coues).* **BAIRD'S SANDPIPER.**

Regular migrant in small numbers. Most often found in May, but frequently in August and up to the middle of September. In 1872 and 1873, the years the waders remained in such numbers the entire summer at Lake Koshkonong, they were the most abundant ever known, before or since. With the exception of these two years we have no records of summer specimens, and even at that time had no suspicion that those remaining bred. Mr. Clark finds this sandpiper a regular migrant in Dunn County, and has sent us specimens. Contrary to our observation he finds *bairdii* more common than *fuscicollis.*

Tringa minutilla *Vieill.* **LEAST SANDPIPER.**

Common migrant, especially in May and August. Arrives about May 1 and a few remain until well into June. The greater part are back again by the middle of August, many having already returned by the first of the month. We have known of at least two instances of this bird's nesting within the state, and from specimens seen in various parts of the north and central portions of the state, suspect that, at least twenty years ago, it bred in some numbers. Dr. Hoy, in 1852, called it common, and stated that it nested in the reedy marshes. Nelson also found it nesting on the Calumet marshes in northeasern Illinois in June, 1875. A breeding female, shot June 10, 1876, on Lake Koshkonong, and now in the Kumlien collection, has the entire back black, with merely a slight edging of rusty color on the tips of the inner tertiaries. It can hardy be called as plentiful in Wisconsin as the semipalmated sandpiper, and, contrary to the case with that bird, is more abundant on the interior lakes than on the shores of Lake Michigan.

Tringa alpina pacifica *(Coues)*. **RED-BACKED SANDPIPER.**

Very abundant migrant in May along the Rock River Valley, remaining some time in favorable localities. So plentiful are the red-backs at times that we saw, in May, 1899, fifty-three individuals killed by the discharge of a double-barreled shot gun, and the entire flock of several hundred birds immediately alighted among their slaughtered companions, so that the same performance could have been repeated. In the spring all are in full breeding plumage, but show an immense variation in the amount of black on the under parts. On its return in September and October it is much less common, except along Lake Michigan, and is then always in winter plumage. Such specimens as have been found in summer have always proved to be wounded birds.

Ereunetes pusillus *(Linn.)*. **SEMIPALMATED SANDPIPER.**

This little sandpiper is quite abundant in southern Wisconsin during May and the first half of June, and so many are summer residents that one easily gets the impression that it nests. Evidence of breeding is, however, entirely lacking, although specimens shot on Lake Koshkonong June 16, 1897, contained *ova* the size of medium hazel nuts and were in full breeding plumage. The majority of the birds which remain all summer do not assume this dress, however. They begin to gather in considerable flocks, associated more or less with other species, by the middle of August, and remain until there has been a severe freeze. On Lake Michigan this species remains much later than in the interior. Mr. Clark finds it most abundant in Dunn County in August.

Ereunetes occidentalis *Lawr.* **WESTERN SANDPIPER.**

Migrant. Not nearly as common as the preceding, yet of regular occurrence in May and often up to the middle of June. We have no state records for the fall, and have never personally taken it anywhere except on Lake Koshkonong, but it doubtless occurs in all suitable localities, a few individuals with the large flights of ***pusillus***. Much more readily distinguished from the semipalmated when both are in breeding plumage. The somewhat larger bill and the extended reddish-brown patch at the back of the head are distinguishing characters.

Calidris arenaria *(Linn.).* **SANDERLING.**

Common migrant along the shore of Lake Michigan in May, August, September and October. Less common in the interior, especially of late years. Formerly quite common about Lake Koshkonong, and, as with many of the waders, a few non-breeding birds remained all summer. Frequents the sandy shores exclusively, and not the mud flats like most of the shore birds. The winter plumaged adults and young are readily detected among the large flights of smaller sandpipers by their lighter colored feathering.

Limosa fedoa *(Linn.).* **MARBLED GODWIT.**

Formerly not very rare during migrations, but of late years, except along the Mississippi and in the northwestern part of the state, has almost entirely disappeared. Was not considered uncommon by Dr. Hoy in 1852, and a pair seen June 15, 1848, on the Wisconsin River, were supposed to be nesting. Thure Kumlien took his first pair at Lake Koshkonong, May 25, 1855. We have seen the bird in Green Bay and on Lake Winnebago, but our acquaintance with it in Wisconsin is principally from Lake Koshkonong, where it was not rare from 1870 to 1876, and in 1857-59 it was known to nest in two instances, once near Stoughton and once at the lake. There is, in the Kumlien collection a perfect egg taken from the oviduct of a female shot May 28, 1878, in the eastern part of Dane County. Mr. H. Nehrling gives it as breeding in the northern peninsula of Michigan, and it used to nest in Iron County, Wisconsin, and almost certainly along Green Bay. At the present time one of the rarest of the waders in Wisconsin.

Limosa hæmastica *(Linn.).* **HUDSONIAN GODWIT.**

Migrant only. We have never known this godwit to occur anywhere within the state in any numbers, and of late years it must be considered very rare. Dr. Hoy procured a single specimen at Racine, November 1, 1850. At Lake Koshkonong it was taken regularly in small numbers up to about 1885; since then very rarely. Appears to have been more common along the Mississippi River than elsewhere in the state. Three specimens were taken near Albion, June 3, 1870, which is the latest record for spring that we have. These birds were doubtless just about to leave for more northern breeding grounds.

Totanus melanoleucus *(Gmel.).* **GREATER YELLOW-LEGS.**

Common migrant, spring and fall, and also a summer resident in the less thickly settled portions of the state. Arrives from April 10 to April 28, and in autumn often remains until it freezes up. Dr. Hoy, in 1852, says of this species: "Abundant and nests in all large marshes." Mr. Nelson found it breeding in Northeastern Illinois in 1875, and Barry speaks of its nesting commonly in Wisconsin in 1854. Downy young were procured by L. Kumlien near Minnesota Junction in 1882. Noted only as a spring and fall migrant in Dunn County by Mr. J. N. Clark. The greater yellow-shanks is not as abundant as the next, yet occurs in considerable numbers in fall, and being readily called by imitating the note many are shot by gunners. It is in full breeding plumage by May 1 and nests in much the same situations as the next. At Lake Koshkonong it bred at considerable distances from the lake, far out in the miry marshes and did not often visit the lake shore until the young were nearly full grown.

Totanus flavipes *(Gmel.).* **YELLOW-LEGS.**

Formerly an exceedingly abundant migrant, and to a considerable extent a summer resident. Arrives in Wisconsin about the first of May, and rarely remains later than October. Formerly bred at Lake Koshkonong, Horicon Lake, about Lake Pacana, and presumably in other localities. Is shot in large numbers by the gunners at the present time, and is decreasing very fast in numbers. Young, still unable to fly, are yet obtainable about Lake Koshkonong in July, but of late years not commonly. Prefers to nest some distance from the lake shore in the large marshes. So closely does it keep in the marshes during the nesting season that a person might visit the lake shore daily and not see a specimen until the young are almost able to fly.

Helodromas solitarius *(Wils.)*. **SOLITARY SANDPIPER.**

A fairly common summer resident in suitable localities, breeding from the southern counties northward to Lake Superior and beyond. Arrives in southern Wisconsin about May 1, the larger number at once passing on. Returning, the northern birds, together with those which remained to breed, leave early for the south, few being seen after September 15. Not at all a "shore bird," its haunts are almost strictly along wooded streams and about closely timbered ponds. There is no Wisconsin bird of which we have so diligently and systematically sought the eggs, and without success, as this sandpiper. Numbers of times we have found the young just hatched, and judging from the actions of the parents have often been near the eggs.

Symphemia semipalmata *(Gmel.)*. **WILLET.**

None of the older Wisconsin ornithologists found the willet in any numbers. Dr. Hoy and Thure Kumlien spoke of it as a rare summer resident. The specimens secured during the past thirty years were usually taken in May and September, and although there are some records for June, we never found any evidence of nesting. Some numbers pass up the Mississippi and remain, or at least did, during June, in the marshy tracts in the western part of the state, possibly a few nesting. At the present time, however, it must be classed as a rare wader in Wisconsin. A good series taken at different seasons would doubtless prove the occurrence of the western form, *S. s. inornata* Brewst. within our borders at some time, if only as a straggler during migrations.

Bartramia longicauda *(Bechst.)*. **BARTRAMIAN SANDPIPER.**

This once abundant species is disappearing at such a rate that if the decrease in the next twenty years is as great as it has been since 1870 the bird will become extinct. Formerly every meadow, border of marsh, or grassy lake shore contained great numbers of this bird. Of late it is found in limited numbers only, but is a regular breeder, even in the southern counties, about prairie pastures and grain fields. Arrives about the first of April and but few remain after the first hard frost in September. The "prairie pigeon" was but little molested until it became generally known that it was one of our best table birds, and consequently brought a good price in the city markets. From that time on it has been slaughtered both spring and fall in great numbers, and this is still carried on wherever the birds exist in any numbers, and especially during the southern migrations. The abominable practice of hunting with dogs for market during the breeding season no longer pays in Wisconsin, and, thanks to our spring shooting laws, has been to a great extent stopped, but entirely too late to save more than a remnant of the flocks of "upland plover" which once nested within our borders.

Tryngites subruficollis *(Vieill.)*. **BUFF-BREASTED SANDPIPER.**

Rare migrant. During a residence of fifty years in southern Wisconsin Thure Kumlien procured but a single specimen, killed on a prairie in Dane County late in September, 1845. On September 10, 1892, a single young male was killed by L. Kumlien on Rock Prairie, Rock County. Another young male was shot by Mr. Henry Skavlem at Lake Koshkonong, and is now preserved in the collection of the club house on the "Carcajou Farms" at that place. Dr. Hoy (1852) gives the species as "quite common from September 15 to October 10. Never met in spring." Willard (1) gives it as a regular migrant in Brown County. It is unfortunate that these writers have left only the bare statements as above. This species "should" pass through the prairie regions of Wisconsin during spring and fall migrations, but it certainly does *not*, except very rarely, in the central parts of the state. Possibly more frequent in the western counties. We consider it one of our rarest "shore birds." To be looked for in prairie regions only, in such localities as are frequented by the Bartramian sandpiper.

Actitis macularia *(Linn.)*. **SPOTTED SANDPIPER.**

A very common summer resident, arriving late in April of an average year, and remaining until quite late in autumn. Nests from the southern part of the state to Lake Superior in all suitable localities, and almost any situation will suit if near water. Its nests are the most easily found of any of the waders, in fact it seems to display very little ingenuity in concealing the eggs. Does not appear to have diminished in numbers to any great extent during the past thirty years.

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1. List of Birds of Brown Co., Wis.. Acad. Arts and Science. Vol. VI.

Numenius longirostris *Wils.* **LONG-BILLED CURLEW.**

This is one of the species of birds that have been almost entirely driven out of Wisconsin. Formerly not only common, but abundant, it is now so rare as to merit a special notice when found. During the forties, fifties and sixties it bred in suitable localities in different parts of the state. The last exact date of which we have any record for eggs is May, 1859, although it undoubtedly bred at a much later date in less thickly settled parts. From 1860 to 1890 it decreased rapidly, and when found at all it was as a migrant only. During the past ten years we have seen but two or three flocks on the prairie, in spring. As an illustration of the former numbers of the curlew Mr. Skavlem tells of his boyhood experiences, in the early fifties, when he was set to following the plows when breaking up the virgin prairie sod, and gathering up the eggs for the house. The curlew will not stay long on cultivated ground, but leaves with the disappearance of the original prairie sod.

Numenius hudsonicus *Lath.* **HUDSONIAN CURLEW.**

From 1845 to about 1865 this species was fairly common during migrations in the prairie regions. Dr. Hoy writes of finding a few nesting at Fox Lake, June 15, 1848, and Thure Kumlien found the birds in summer in Dane County, and from their actions supposed them to be nesting. We have no *positive* evidence, however, that the species ever bred in the state. It has certainly been decidedly rare during the past thirty years even in migrations, and we have not seen a single specimen for twelve years. "Curlews" are still reported from sections in the northwestern part of the state, but whether of this species or the foregoing is an unsettled question.

Numenius borealis *(Forst.).* **ESKIMO CURLEW.**

Exceedingly rare migrant. Thure Kumlien procured but two specimens during fifty years collecting in the State. Dr. Hoy took several in an early day, but considered them rare. A specimen, which we saw, was also shot in Green Bay in the fall of 1879.

FAMILY CHARADRIIDÆ: PLOVERS.

Sqatarola squatarola *(Linn.).* **BLACK-BELLIED PLOVER.**

Migrant, never very abundant, but occurring singly or in small flocks, both spring and fall. Generally visits southern Wisconsin about the middle of May, among the large flights of other shore birds, the great majority passing north about the first of June and returning late in August. If the weather is fine some remain until late into October. Numbers formerly remained, even in southern Wisconsin, the summer through, but we have no evidence of nesting; although Mr. Nelson seemed strongly to suspect that it did breed about Waukegan, Illinois, in 1876. That a few do nest not *very* far north of us is shown by the fact that young with the primaries still showing the remains of the "blood quills" used to be taken on Lake Koshkonong in August (Aug. 10, 2 specimens, Aug. 14 and 16, 1872, 1873). Older birds not in full breeding plumage also formerly occurred on Lake Koshkonong during June, July and August. During the past ten years the species has almost entirely disappeared. Mr. J. N. Clark considers it a very rare migrant in Dunn County, and has not seen a specimen since May 27, 1898.

Charadrius dominicus *Müll.* **AMERICAN GOLDEN PLOVER.**

Formerly very abundant, both in spring and fall, on the Wisconsin prairies, if there were heavy rains arriving about April 15 and remaining until the first week in May or even later (May 10, 12, 13, 1867, Rock County). Returns from the north from the first to the middle of September, but is much more common in October. Formerly an occasional specimen was taken in summer, but it is very rare at this time as compared with the last. There are several Koshkonong records for June and July, and a beautiful male in full breeding plumage was taken on Rock Prairie, Rock County, in June, 1892. Spring market shooting from Illinois southward and westward has so reduced its numbers that the golden plover is now almost rare in Wisconsin. A few are still found on the larger prairies in April and about the lakes in September and October. Late arrivals in spring are in almost perfect plumage. The numbers of these birds that frequented our prairies from 1840 to 1865 seem almost incredible to the younger generation. At that time the birds would scarcely get out of the way of the teams when the farmers were plowing, and followed, like chickens, in the furrow.

Ægialitis vocifera *(Linn.).* **KILLDEER.**

A common summer resident in suitable localities over the entire state. An early arrival in the spring often occurring as early as March 15, and there are even February records for the southern counties. Breeds early and departs for the south as soon as the ice forms.

Ægialitis semipalmata *Bonap.* **SEMIPALMATED PLOVER.**

Common migrant during May and first two weeks of June, and again during August and September. Numbers remain about the larger inland lakes and Lake Michigan during the summer. We procured the young, ***still unable to fly,*** at Lake Koshkonong on one occasion. Specimens are often taken in August with the natal down still adhering to the feathers of the head and neck. Mr. Nelson believed that the species nested in northeastern Illinois in 1873, and near there at least in following years, and we are of the opinion that he was wholly correct in his surmises to that effect.

Ægialitis meloda *(Ord.).* **PIPING PLOVER.**

Not nearly as common in the interior of the state as the preceding species, but more frequent on Lake Michigan. Arrives earlier than the semipalmated. Formerly bred sparingly about Lake Koshkonong and near Sheboygan on the lake shore. At the present time the bird is too rare to get any definite information regarding its occurrence. From 1870 to 1900 this form did not frequent Lake Koshkonong and the surrounding lake country in such numbers as the next, or at any rate more specimens were procured with the complete "ring" than without. Dr. Hoy met with it only in fall and considered it uncommon, but at that date, 1852, did not of course recognize the two varieties. In June and July, 1873, the ring-necks were much more abundant at Lake Koshkonong than at any other time, before or since, of which we have record.

Ægialitis meloda circumcincta *Ridgw.* **BELTED PIPING PLOVER.**

What has been written in regard to the preceding variety applies equally to this form, except that *circumcincta* occurs in greater numbers. For some unexplainable reason this species, in common with all waders, and even those kinds which are never hunted, has greatly decreased in numbers of late years. This sub-species once bred about Lake Koshkonong and other favorable lakes, but is now almost entirely absent, except a limited number during migrations.

FAMILY APHRIZIDÆ: SURF BIRDS AND TURNSTONES.

Arenaria morinella *(Linn.).* **RUDDY TURNSTONE.**

Not an uncommon migrant, especially in spring. A few may be found in the large flocks of waders by May 20. These birds are in the full breeding plumage which they still retain when they return in August. Those procured in September begin to show the change to the winter dress. More common along the shore of Lake Michigan than in the interior. Small numbers remain about Lake Koshkonong until well into June, and a few in exceptional years remained all summer, but there was no evidence that they bred, as they very likely did not. We have seen these birds about Ontonagon, Michigan, in the latter part of July, and in Green Bay late in June; still they unquestionably breed only far north of us. Greatly reduced in numbers of late years.

ORDER GALLINÆ: GALLINACEOUS BIRDS.

FAMILY TETRAONIDÆ: GROUSE, PARTRIDGES, ETC.

Colinus virginianus *(Linn.).* **BOB-WHITE.**

Formerly a very abundant resident in southern and central parts of the state. In most sections the quail gradually decreased in numbers until about 1885 they were entirely absent from many localities where they were once common. The clearing away of underbrush and the introduction of wire fences in place of the old-fashioned rails, with their weed covered space on each side, probably had as much to do with their disappearance as too close or lawless shooting. For the past dozen years different shipments of birds, mostly from Kansas, have been turned loose in various localities. In some of these places the introduced birds seem to thrive wonderfully, and having been constantly protected by law for a term of years there seems good reason to think that the quail will in many sections become common again. A great deal has been said and written in regard to the introduction of these birds from a more southern latitude—that they could not withstand the winters of Wisconsin, etc. We have observed them very closely and doubt that there is any cause whatever for alarm. With the abundance of feed that is nowadays left out in every field, careful observance of the laws, and constant vigilance over that class of pot-hunters who, if they had their way, would destroy every game bird and animal in a year's time, there is no reason why the birds should not thrive and multiply.

Canachites canadensis canace *(Linn.)*. **CANADIAN SPRUCE GROUSE.**

Fairly common resident in the pine regions of the state, but so far as we can learn has never been found south of the pine belt. Appears to be disappearing at rather a rapid rate, just why is not easily answered. We have personally met this species in different portions of northern Wisconsin for the past twenty-five years, but in constantly decreasing numbers. In some sections of our extreme northern counties many still remain.

Bonasa umbellus *(Linn.)*. **RUFFED GROUSE.**

Common resident in favored sections of the south and central parts of the state, and almost abundant in some of the northern counties. The gradual clearing up of underbrush and tangled thickets, and the pasturing of woodland lots have driven the "partridge" from many of its old haunts. In the sections of northern Wisconsin where the grouse are still abundant, every subterfuge possible is practiced to evade the law in regard to shipments and the number each hunter is allowed to carry on the trains, and great quantities find their way into the city markets despite the strict and careful vigilance of the game wardens.

Bonasa umbellus togata *(Linn.)*. **CANADIAN RUFFED GROUSE.**

Typical *togata* is rare in Wisconsin. A number of grouse supposed to be of this form appear to be only intermediates, and typical *umbellus* occurs in the most northern counties. In the Milwaukee Public Museum, however, are several examples of the true Canadian ruffed grouse, one especially typical example collected by L. Kumlien at Hudson, St. Croix County. A careful search will doubtless show this form, but only as a rarity, in the northwestern part of the state. Mr. Wm. Brewster writes us that although the Wisconsin and Michigan grouse that he has examined are darker and grayer than those from New England, they appear to be nearer *umbellus* than to true *togata*, which almost invariably has the entire throat barred transversely with dusky markings, a feature not found in our birds.

Lagopus lagopus *(Linn.)*. **WILLOW PTARMIGAN.**

Exceedingly rare straggler from the north. Two specimens were captured in a trap at Racine in December, 1846, by Dr. P. R. Hoy. His additional note, in his list of 1852, that it "nests in the tangle of evergreen swamps in the northwestern parts of the state" rested on information furnished him by Indians, as he himself informed us years afterward. Many years ago a well known friend of ours, and a reliable naturalist, Prof. W. F. Bundy, furnished us with a note to the effect that he procured a ptarmigan in Sauk County in 1876. We are at present unable to learn Prof. Bundy's address and can give no details of this capture. Some time in the fifties a land hunter from the northern part of the state brought a mutilated, frozen ptarmigan to Thure Kumlien to show that his assertion that these birds, well known to him in his native Norway, *did* exist in Wisconsin, as Kumlien had probably intimated that they did not. During our sojourn on Lake Superior we made repeated inquiries in regard to this bird and received some interesting information — such as it is. It is certain, however, that the ptarmigan occurs as a rare winter visitor in the northern peninsula of Michigan, and formerly at least reached Wisconsin during the severest weather.

Tympanuchus americanus *(Reich.)*. **PRAIRIE HEN.**

Common resident in many parts of the state. The prairie chicken seems to have moved westward with the settlement of the country. In the early forties it was rather rare in southern Wisconsin, and at the present time has almost entirely replaced the next. The species thrives well in cultivated sections if reasonably protected. Sensible legislation has resulted in a marked increase in its numbers during the past ten to fifteen years, and on the prairies and large tracts of wild dry marsh land, where it is allowed to nest unmolested, it is still quite plenty.

Pediœcetes phasianellus campestris *Ridgw.* **PRAIRIE SHARP-TAILED GROUSE.**

Resident. The sharp-tails seem to be rapidly giving way to the prairie hen, a species better adapted for life in a settled country. Referring back to 1840, we find that this species was the common prairie grouse of southern Wisconsin, and was at that time extremely abundant. Thure Kumlien had been a resident of Wisconsin several years before he saw a specimen of what is now our common prairie chicken. Dr. Hoy in 1852 says, "formerly quite common near Racine, now seldom met with." Mr. J. N. Clark writes us from Dunn County, "quite common up to about 1885, but now (1902) becoming very rare. Saw it last in 1900. Have never found it in company with the pinnated grouse, which is common here now." A few sharp-tails were found about Stevens Point in 1898, and scattered records have been received from Markesan and other points in the north central part of the state. The last record we have for southern Wisconsin is near Janesville, October, 1869 (specimen preserved). At the present time it is found in any numbers only in isolated sections of the central and northwestern part, and is probably doomed to speedy extinction in the state.

FAMILY PHASIANIDÆ: PHEASANTS, ETC.

Meleagris gallopavo fera *(Vieill.).* **WILD TURKEY.**

The wild turkey is to-day so rare in Wisconsin that it is safe to say that it is extinct. Authentic references are meagre and fragmentary. Dr. Hoy and others say it was abundant in southern Wisconsin prior to 1840. Several references, of which Hoy's is one of the most reliable, state that the winter of 1842 was practically fatal to them. The explanation as given is that "snow was yet two feet deep in March, with a stout crust, so that the turkeys could not get to the ground. They became so poor and weak that they could not fly, and thus became an easy prey to the wolves, foxes, wild cats, minks, etc., which exterminated almost the entire race" (1). Dr. Hoy speaks of turkeys last being seen at Racine in November, 1846. A fine specimen was shot at Waukesha in 1847. Mr. Skavlem, of Janesville, tells us that the last known record for Rock County was in the town of Newark, in 1854. Thure Kumlien had no records for Lake Koshkonong later than 1842. Said to have been killed in some numbers in the southwestern part of the state as late as 1856-58. Residents of the extreme southwestern counties claim that a few were found among the bluffs near the river as late as 1894, and it is highly probable that

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1. Hoy. Large animals,—time of their disappearance." History of Walworth Co., Wis., 1882. p. 138.

they were. Newspaper reports claim the capture of three at Boscobel in 1872. A few birds have been introduced and escaped from captivity of late years about Koshkonong, and it is not an impossibility that genuine "wild" turkeys may yet be taken in Wisconsin.

ORDER COLUMBÆ: PIGEONS.

FAMILY COLUMBIDÆ: PIGEONS.

Ectopistes migratorius *(Linn.).* **PASSENGER PIGEON.**

The wild pigeon was an abundant migrant and summer resident in many parts of the state until the years 1879-83. From that time to the present day the bird has been one of our rarest species. Mr. J. M. Blackford, now residing at Delavan, states that the last large catch of the netters was in 1882. The following spring but one hundred and thirty-eight dozen were taken in the best pigeon grounds in the state, and this was practically the end. Small flocks, pairs and solitary individuals have been reported from various parts of the state nearly every year since this time, however, and it is highly probable that a very few still nest in isolated pairs within its limits. Mr. J. N. Clark furnishes the following data for the past fifteen years in Dunn County: May 2, 1886, a nest containing one egg; June, 1890, nest containing one young; April 20, 1897, 3 seen, 1 taken; April 26, 1897, 3 seen; April 27, 1897, 2 seen; May 5, 1898, 1 pair seen, last record. Several have been taken and more seen about Milton during the same period of years. The last record of capture for Delavan was an immature male, single bird, taken at Delavan Lake, September 8, 1896. Mr. W. E. Snyder (1) reports but two records of the capture of pigeons at Beaver Dam in thirteen years.

Zenaidura macroura *(Linn.).* **MOURNING DOVE.**

Common summer resident. A few remain in southern Wisconsin through the winter, but the greater number arrive from the south about the first of April. In autumn the mourning dove is to some extent gregarious and the most of them move southward during October. One of the birds that is little affected by civilization and has so changed its habits that it is

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1. Bulletin of Wis. Nat. His. Soc. II, 2, p. 110.

now a regular and common breeder in thickly settled parts of every village, and even the large cities, and when unmolested becomes very tame.

ORDER RAPTORES: BIRDS OF PREY.

FAMILY CATHARTIDÆ: AMERICAN VULTURES.

Cathartes aura *(Linn.)*. **TURKEY VULTURE.**

Of regular occurrence along the Mississippi at least as far north as Pierce County. We have records also for Racine, Milwaukee, Two Rivers, De Pere, Beaver Dam, Delavan, Stevens Point, Iron River (Bayfield County), etc., becides more than a dozen for Lake Koshkonong. These records are principally in July and August, although it has been taken at Koshkonong as early as April 28 and as late as November 2. The specimens are mostly young of the year. Grundtvig reports the vulture from Outagamie County in 1882 and 1883, and thinks it breeds near Shiocton, where he noted it during April, May, August and September (1). The species undoubtedly breeds sparingly in the southwestern part of the state. The principal food of the "buzzard" at Lake Koshkonong seems to be dead fish. There is a general impression among many people in the north that this bird, as well as all others of the *Raptores*, is in some manner "destructive" and should be killed at sight. This opinion prevails among many who should know better. The safe plan to follow is that *all* birds should be protected. We are not believers in the so-called "injurious" species and hope to see the day when no distinction will be made as to the birds which shall be protected.

FAMILY FALCONIDÆ: FALCONS, HAWKS, EAGLES, ETC.

Elanoides forficatus *(Linn.)*. **SWALLOW-TAILED KITE.**

Thure Kumlien found this species breeding near Fort Atkinson in the summer of 1854. Prior to this date it was noted at different times in Jefferson, Rock and Dane Counties. According to Dr. Hoy it nested near Racine up to 1848, but

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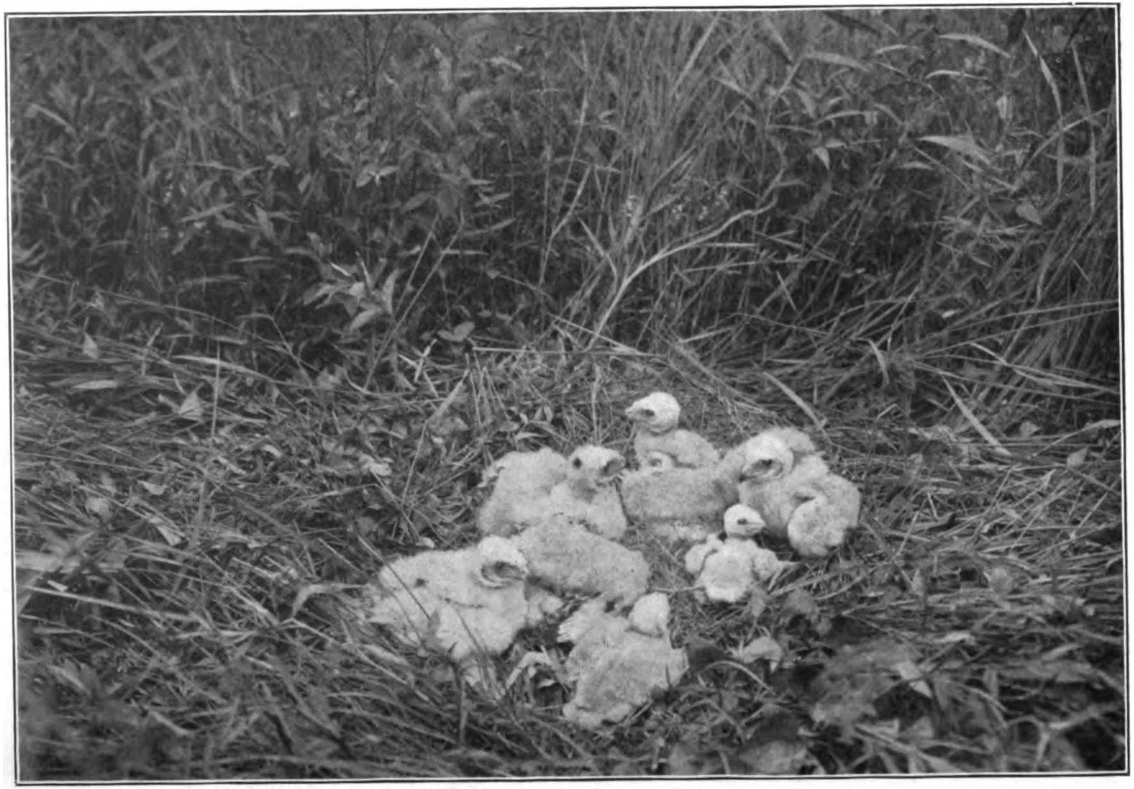
1. Trans. Wis. Acad. Sciences, Arts and Letters X. p. 107.



NEST OF YOUNG MARSH HAWKS.

Photo. by F. F. BURROWS.

abandoned the region about that time. He states that "they nested on tall elm trees about the 10th of June, and left us about the 1st of September" (1). Rev. Mr. Barry, also writing of the vicinity of Racine in 1854, says, "at one time quite numerous upon our prairies, and quite annoying to us in grouse shooting; now rarely met with in this vicinity." There is a specimen in the Milwaukee Public Museum, male, taken in Milwaukee County, May 15, 1888. Along the Mississippi River the swallow-tailed kite is more common and may still rarely breed. It is still a rare summer visitant in the east and central counties.

Circus hudsonius *(Linn.)*. **MARSH HAWK.**

One of the commonest hawks of Wisconsin, in marshy or prairie sections. A summer resident, though specimens are frequently taken in southern Wisconsin as late as well into December. Nests in all suitable localities from the southern tier of counties northward. The marsh hawk subsists largely on frogs, etc., but does not hesitate to attack any smaller bird that it can overtake, even molesting the poultry about the farms bordering large marshes or low prairies. About reedy lakes where duck shooting is carried on it systematically hunts along the border of the lake for crippled ducks. We have even known it to carry off a dead duck but a short distance from the hunter who had just shot it. Appears to be more plentiful than thirty years ago.

Accipiter velox *(Wils.)*. **SHARP-SHINNED HAWK.**

Very common as a migrant during the latter part of April and first three weeks of May, and again during September and October. A few remain during mild winters in the southern part of the state. We have found it nesting at Milton in two instances, but the majority go farther north. We have nesting records from Stevens Point, Iron County, Two Rivers, Madison, Racine, and, in fact, from so many widely separated localities that it can without doubt be considered as breeding at suitable points throughout the state, in greater numbers in the central and northern parts. During migration, both spring and fall, it follows the flights of smaller birds, feeding almost exclusively on them, and must destroy great numbers.

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1. Trans. Wis. State Agric. Society, 1852, p. 343.

Accipiter cooperii *(Bonap.).* **COOPER'S HAWK.**

Common summer resident, even in thickly settled parts of the state. Arrives in southern Wisconsin about the middle of April, and remains until the middle of October. Nests commonly in the black oak groves of "second growth" timber, but is in no wise restricted as to kind of tree. We have taken a set in a tamarack in a heavy swamp, and even in poplars. By far the most destructive hawk to poultry during the summer season. For daring, boldness and destructiveness it is only equalled by the goshawk in winter. Nests early in May, and frequently a second brood is reared. This hawk will at times nest in close proximity to a farm house, but with a great display of cunning will draw on some distant poultry yard for supplies until the young are ready to leave the nest. This hawk is much more common than thirty years ago, at any rate locally. In rare instances noted during mild winters in southern Wisconsin.

Accipiter atricapillus *(Wils.).* **AMERICAN GOSHAWK.**

A regular winter resident, formerly even well into Illinois. At the present time the goshawk is becoming rarer, even in the central and northern parts of the state. Dr. Hoy, in 1852, speaks of it as occurring at all seasons, the adults only in winter. Our personal recollection is that it was the young birds which were so destructive to poultry thirty years ago, in winter. Barry writes of its abundance in the early fifties, mentioning that a friend shot twenty in one season. Thure Kumlien considered it a rare summer resident at an early day, but personally or from other observers we have no positive nesting records, although the species perhaps bred in the northern portions of the state. Mr. J. N. Clark finds it a regular winter visitant in Dunn County, some winters abundant, but growing less common. We have taken three adults at Milton during the past ten years. Lives almost exclusively on grouse, poultry, rabbits, etc., and is very destructive.

Buteo borealis *(Gmel.).* **RED-TAILED HAWK.**

A common species, resident in southern Wisconsin, though much more numerous during spring and fall migrations. Nests in all sections of the state, even in quite thickly settled localities. Commonly called "chicken hawk" or "hen hawk," but in no wise as destructive a bird as is generally supposed.

Buteo borealis kriderii *Hoopes.* **KRIDER'S HAWK.**

This western-plains race of the red-tail is a regular fall and spring visitant in western Wisconsin, in small numbers. Mr. J. N. Clark has kindly loaned us a very fine and typical specimen shot by himself at Meridian, Dunn County, October 22, 1892. He states that it is of regular occurrence there in spring and fall, though by no means common. Three specimens, all perfectly typical, have been taken at Lake Koshkonong during the past few years, one of which is preserved in the collection of the Oshkosh Normal School.

Buteo borealis calurus *(Cass.).* **WESTERN RED-TAIL.**

Of rare, but regular occurrence in Wisconsin in the late fall. Six or eight specimens were procured about Lake Koshkonong by Thure and L. Kumlien; one specimen, taken in November, 1873, was pronounced by Prof. Baird as "extra dark" and perfectly typical. A single specimen was taken at Delavan, October 19, 1901. Mr. J. N. Clark has loaned us an extra fine female shot by himself at Meridian, Dunn County, October 25, 1893. This specimen is of solid dark color, with the exception of the reddish-brown blotch across the breast, and has an exceptionally bright reddish tail, crossed by ten black bars and with a wide black terminal band. This specimen is probably very much like the one mentioned by Coues (1) as "chocolate-brown, with a great reddish blotch on the breast."

Buteo lineatus *(Gmel.).* **RED-SHOULDERED HAWK.**

In the early days this hawk was considered a common species by nearly all observers. At the present time it is certainly by no means a common bird in Wisconsin, and at any distance from Lake Michigan seems to be decidedly rare. Appears to nest irregularly at different places, most often at points not far from Lake Michigan. Mr. Clark has taken but one specimen in Dunn County, April 27, 1891, and considers it a very rare species there. Grundtvig failed to find it in Outagamie County, or Willard in Brown County. Mr. W. E. Snyder records but one capture from Dodge County (2). But few have been taken at Koshkonong since 1870, and we have but one specimen from Delavan.

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1. Key to N. A. Birds, Fourth Ed. p. 545.
2. Bull. Wis., Nat. His. Soc. II, 2, p. 110.

Buteo swainsoni *Bonap.* **SWAINSON'S HAWK.**

Although this hawk is very common to the northwest of us — in Minnesota and Dakota — it is not a common species in Wisconsin. Dr. Hoy apparently met only the young, which he called *vulgaris*, and later described as a distinct species, under the name of *B. bairdii*, a mounted specimen remaining so labeled in his collection to this day. Mr. J. N. Clark has procured but a single specimen, in December, 1896, in Dunn County. Grundtvig did not secure a specimen in Outagamie County, and Willard does not include it in his list of Brown County birds. King calls it a "summer resident," on what authority we do not know, as he apparently did not procure a specimen. Thure Kumlien procured perhaps a dozen specimens during his long period of collecting at Lake Koshkonong, and half as many more have been taken by L. Kumlien. Here it has been noted only during the autumnal migrations, in September and October. Probably occurs more frequently along the Mississippi River than in the eastern or central parts of the state.

Buteo platypterus *(Vieill.).* **BROAD-WINGED HAWK.**

In eastern Wisconsin rather a common spring migrant, and especially common in fall. By no means a common nesting species, but is a summer resident and breeds from the southern tier of counties northward. In Dunn County Mr. Clark considers it on the whole an uncommon species, but has seen and taken it a number of times. According to our observations, this is the hawk that "flocks" in the fall, ofttimes in great numbers. Occasionally several hundred may be seen at a time, often ten to twenty in one tree. These migrations seldom last but a day or two and are of irregular occurrence. Other authorities speak of these "hawk flocks" being made up of all the smaller species in general and the red-shouldered in particular, but our observation has been that the flocks are invariably of this species alone.

Archibuteo lagopus sancti-johannis *(Gmel.).* **AMERICAN ROUGH-LEGGED HAWK.**

Very common migrant, and, unless the weather be too severe, a common winter resident in southern Wisconsin An occasional specimen is found as late as the middle of April, but rarely later, although there are records of individuals remaining through the summer. In May, 1872, a pair of these hawks was found nesting in the eastern part of Dane County by L. Kumlien. The nest was placed in a low bur oak, about eight feet from the ground, and contained three eggs, well incubated. This set was sent to Dr. Brewer. The female had been wounded, the primaries of one wing sticking straight up, even when the bird was sitting. She could make but short flights and this is in all probability the cause of the pair remaining here to breed, and it must be considered as an exceptional record. Extremely variable in plumage.

Archibuteo ferrugineus *(Licht.)*. **FERRUGINOUS ROUGH-LEG.**

On November 10, 1893, a pair of these hawks was procured by L. Kumlien at Lake Koshkonong. They were flying low over the rushes a short distance from shore, and one was secured with each barrel. October, 1894, another was taken at the same locality and came into our possession. We are positive of having seen the species in the western part of the state, but the above are the only records of capture obtainable for Wisconsin. These birds are preserved in the Kumlien collection.

Aquila chrysaëtos *(Linn.)*. **GOLDEN EAGLE.**

Rather a rare bird in Wisconsin. Obtained principally from October to March, though there are several records for southern Wisconsin both earlier and later. During the past fifteen years we have handled about fifteen specimens taken at various localities throughout the state. Dr. Hoy records the nesting of this species in a large oak tree between Racine and Milwaukee in 1851, and had the egg in his collection some years ago. To us, however, the egg looked very similar to that of the bald eagle. This eagle is exceedingly variable in size. The Museum of Milton College contains perhaps the greatest extremes extant, one a gigantic female which fiercely attacked a man who was carrying a deer upon his back, in Chippewa County, the other, a male, less than thirty inches in length. During the winter the golden eagle resorts to any carcass of a dead horse or cow that has been left exposed and are then easily secured. We have the details of several instances where it has been suddenly surprised while feeding, and instead of retreating, as might be expected, has turned and fiercely attacked the intruder, sometimes with such vigor as to drive an unarmed man away.

Haliæetus leucocephalus *(Linn.).* **BALD EAGLE.**

The summer resorts about our lakes have gradually driven this species from its former nesting haunts. Bred about Lake Koshkonong twenty-five years ago; one nest at least, or the same tree, had then been occupied by the birds for over twenty years. In southern Wisconsin at the present day the eagle is mainly a spring and fall migrant about the inland lakes, but specimens are occasionally seen in mid-summer. Still nests, not rarely, in Vilas County and in many of the sparingly settled portions of the northern part of the state. The young birds move southward some time in advance of the adults. Not at all rare along the Mississippi, but seems to prefer to nest in the vicinity of inland lakes.

Falco peregrinus anatum *(Bonap.).* **DUCK HAWK.**

Of regular occurrence during the migrations, both spring and fall, principally along the water courses. Was never very common in any part of the state that we can learn. Formerly bred at Racine, and has been known to remain at Lake Koshkonong through the summer. Mr. Clark has taken it in Dunn County, but considers it "rather uncommon." We have seen it in summer along the south shore of Lake Superior, where it appeared to be nesting on the rocky ledges. We have several times had this hawk swoop down and pick up a duck we had just shot before we could reach it. It frequently kills a duck too large and heavy to carry to the shore, and in this case secures a firm hold in the duck's back, and flying, drags it along on the surface of the water to the shore.

Falco columbarius *Linn.* **PIGEON HAWK.**

A rather common migrant during the latter part of April, generally through May, and again during September and October. At the present time a rare summer resident in southern Wisconsin, but it not infrequently remains in the central and northern parts of the state. Dr. Hoys speaks of its nesting near Racine in 1852. Grundtvig called it abundant in Outagamie County in 1882-3. We have found it fairly plenty in several sections of the northern part of the state. Considering the large numbers seen, and even procured, it is remarkable that so few are in the full blue plumage. A perfect falcon in every sense of the word, with all the boldness, daring and dexterity of its larger relatives.

Falco richardsonii *Ridgw.* **RICHARDSON'S MERLIN.**

A migrant only in Wisconsin, and not noted by us except in autumn. We have two specimens from Stevens Point and have taken it several times during the past ten years at Lake Koshkonong. Does not arrive until some time after the pigeon hawk, which is probably accounted for by the fact that it breeds much farther from our lines than that species. Our latest fall record is November 29 (1896). Several specimens were taken by Thure Kumlien, but as he did not consider it specifically distinct from *columbarius* a reference to his notes is of little value in the present connection. A fine specimen in Mr. Skavlem's collection was shot near Janesville in the late fall of 1886. This species is usually readily distinguished from the preceding by its slightly larger size, its conspicuously banded tail—the latter crossed by six distinct ashy-white bands—the amount of ochraceous brown markings on primary coverts, and withal its much lighter color in any plumage. We often get specimens however, which appear to be intermediate, or at any rate not typical of either, and hard to determine.

Falco sparverius *Linn.* **AMERICAN SPARROW HAWK.**

Common summer resident, especially in heavily wooded regions. Where the larger trees are cut away it is far less common during summer than formerly. So far as we are able to learn the sparrow hawk is found in all parts of the state, but more commonly in the heavily timbered hardwood districts.

Pandion haliaëtus carolinensis *(Gmel.).* **AMERICAN OSPREY.**

Summer resident in all suitable localities in the state, but not common anywhere. Noted more frequently in autumn, September to November, on the larger lakes and rivers. More plenty in the Rock River Valley and thence eastward to Lake Michigan, than in the western part of the state, except along the Mississippi River. Summer resorts, with all the attendant features, have driven the fish hawks from many of the smaller lakes where they formerly bred. A specimen was found washed ashore on Lake Koshkonong, in June, 1898, with both feet firmly imbedded in the back of a very large carp; the fish had proved too large for the hawk, and he had weakened in the struggle and drowned.

FAMILY STRIGIDÆ: BARN OWLS.

Strix pratincola *Bonap.* **AMERICAN BARN OWL.**

Although Wisconsin is rather far north for this species, specimens are occasionally taken, especially in the southern half. Dr. Hoy records it from Racine; one specimen was taken at Pine Lake in the forties; two or three have been taken in Jefferson County at an early day; and one specimen in the Whitewater Normal School was taken near that city in 1899. Mr. F. F. Pierson, of Janesville, mounted a specimen shot near that place in the winter of 1901-02. It is also noted from La Crosse and Ripon (1). The only authentic breeding record we have for the state is furnished us by Mr. H. H. T. Jackson, of Milton, who saw in Green County in April, 1899, a live female with three eggs, which had been taken from a hollow bur oak tree.

FAMILY BUBONIDÆ: HORNED OWLS, ETC.

Asio wilsonianus *(Less.).* **AMERICAN LONG-EARED OWL.**

Formerly a very common resident. In such localities as furnish thick shelter, tangled underbrush and dense thickets, and undisturbed spots, it is yet quite common. More strictly nocturnal than the next. In southern Wisconsin almost invariably makes use of a last year's crow's nest, to which is added a lining of various materials, and in this part of the state two broods are often reared in a season.

Asio accipitrinus *(Pall.).* **SHORT-EARED OWL.**

More common, at least locally, than formerly. In prairie and marshy regions a very common fall migrant, to a less extent a winter resident, and not infrequently remains throughout the summer and breeds, even in the southern counties. The species has been known to nest at Delavan, Albion, Stoughton, Stevens Point, and more commonly (?) in the north and north-central parts of the state. Is commonly seen hunting over the marshes on cloudy days, and during the nesting season is frequently noted about at any time, often sailing high overhead like a hawk. Except, perhaps, during the nesting time, when it feeds the young largely on birds, it is very beneficial, existing almost entirely on mice, grasshoppers, etc. A

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1. Cooke, Bird Migration in the Miss. Valley, U. S. Dept. Agriculture, 1888, p. 121.

nest found at Delavan, May 29, 1898, contained three young, of different sizes, and afforded a rather surprising lesson as to the destructiveness of this species to smaller birds during the breeding season. The young were probably ten to fourteen days old, and were literally resting on a mass of wing and tail feathers of the victims of their appetites. From this mass we picked out over six hundred feathers, and at the bottom of the nest the feathers were so mouldy and mixed with grass that no attempt was made to count or identify them. From those in a good state of preservation and reasonably fresh we positively identified the following varieties, all entirely unexpected, as we had always looked upon this species as pre-eminently a mouse and insect eater: *Icterus galbula, Galeoscoptes, Hylocichla, Toxostoma, Vireo, Cistothorus, Piranga erythromelas, Agelaius phœniceus, Dolichonyx, Lanius!* (one nearly entire tail), *Seiurus aurocapillus, Dendroica æstiva, Geothlypis trichas, Setophaga ruticilla, Coccyzus, Regulus* (2 tails), *Porzana carolina, Porzana noveboracensis, Actitis macularia, Ægialitis vocifera, Spiza americana, Antrostomus vociferus* (at least two), *Sialia sialis, Zamelodia ludoviciana, Sturnella magna, Pipilo erythrophthalmus,* tyo species of small *Tyrannidæ,* and among the large number of wing and tail feathers of warblers were *Dendroica maculosa, D. blackburniæ, D. cærulescens,* and *D. rara,* as well as others of this family, and several species of sparrows it was impossible to determine. No trace of a mammal was found either about the nest or in the pellets around it.

Syrnium nebulosum *(Forst.)*. **BARRED OWL.**

Resident, but of irregular distribution. Like a number of other birds, both residents and migrants, this owl prefers such localities as have not undergone much change from the wild state. Where the woods have been too much cut away and the larger trees removed, it is no longer common. In the tracts that have not been disturbed, however, the barred owl is, perhaps, with the exception of *Megascops*, the commonest owl in Wisconsin. A common nesting species about Delavan, and northward in all suitable localities. We have never known this species to nest in other situations than the hollows of trees, with the exception of one nest placed on the top of a broken stub, only twelve feet high. In this case, however, it was reasonable to suspect that the nest had already been occupied before the tree had broken off.

Scotiaptex cinerea *(Gmel.)*. **GREAT GRAY OWL.**

Rare winter visitant. This great owl seldom reaches southern Wisconsin, especially of late years. Before the heavy timber was cut down specimens were sometimes known to reach even the southern tier of counties. Recorded by Dr. Hoy from Racine in 1848. Two specimens were sent Thure Kumlien from Bark River woods, Jefferson County, at about the same time. We have received two specimens from Iron River, taken in November, 1891. Deer hunters from the northern counties sometimes bring down specimens; probably half a dozen reached Thure Kumlien from this source during many years. If we could trust reports from hunters and residents in the Lake Superior region we would say that it is not rare in winter in that section, particularly during severe weather.

Nyctala tengmalmi richardsoni *(Bonap.)*. **RICHARDSON'S OWL.**

A very rare visitant in southern Wisconsin during winter. Probably occurs more frequently in the northern part of the state. Dr. Hoy records a single specimen taken at Racine, November 30, 1850. Thure Kumlien procured three or four specimens in Dane and Jefferson counties during nearly fifty years residence in these parts. L. Kumlien has taken two, one in Dane County, 1869, and one at Fort Atkinson, August, 1872. Mr. J. N. Clark, of Meridian, Dunn County, took one specimen February 24, 1893, at that place, capturing it in his hands from the side of a straw stack. One specimen (no record) is preserved in the Milwaukee Public Museum.

Nyctala acadica *(Gmel.)*. **SAW-WHET OWL.**

This little owl is most often found in Wisconsin in winter, but this is when food is scarce and it consequently comes about barns and dwellings, and is more frequently seen. It certainly used to breed in Jefferson County and Thure Kumlien took specimens in May, and at least once in August. For some reason it is not as common as formerly. Dr. Hoy, writing in 1852, considered it common at Racine, and it was known to breed there. Some of his specimens of *Nyctala kirtlandii* (= juv. *acadica*) were hatched near that place. Willard also claims it as a breeding bird for Brown County. Mr. Clark considers it rare in Dunn County. In the Copeland-Russel collection in Milwaukee are four specimens, three from Iron County, September and October, 1898, and March, 1899, and one from Waukesha County, November 19, 1897. During the winter of 1889-90 two specimens remained about the barns on the Kumlien homestead at Milton all winter. The larger of these, presumably the female, hunted a great deal during the day time, and became an expert sparrow catcher. Its mate did not seem nearly so expert, yet he did not go hungry as it was a common sight to see both owls feeding from the same sparrow. These birds became very tame, so that one could almost put his hands upon them.

Megascops asio *(Linn.).* **SCREECH OWL.**

Common resident, more so apparently in settled portions of the state than away from civilization. Nests even in villages and towns of some size, wherever it finds hollows that will serve as nesting sites. Though naturally subsisting largely on mice it becomes a great sparrow catcher when living about towns and farm houses. One of our most beneficial birds, but, unfortunately, its usefulness is not universally recognized.

Bubo virginianus *(Gmel.).* **GREAT HORNED OWL.**

Resident. With the disappearance of the heavy timber this owl has gradually become less and less common in the south and central parts of the state. In well wooded regions it is still locally common, and clings to such patches of timber as have escaped the general destruction. Usually more plenty in the hardwood timber of bottom lands along streams, or banks of lakes. Supposedly resident wherever found, but there appears to be some southward migration late in fall and during severe winters. Breeds as early as the middle of February. Wisconsin specimens are exceedingly variable in color, ranging from very dark birds to specimens so light as to almost pass for *pallescens.*

Bubo virginianus arcticus *(Swains.).* **ARCTIC HORNED OWL.**

A rare winter visitant, at least in southern Wisconsin. Taken by Hoy at Racine and by Kumlien at Lake Koshkonong, both at an early day. A fine specimen, preserved in the Milwaukee Public Museum, was procured at Ashland, January, 1886. Mr. Witmer Stone has examined the type of Hoy's *subarcticus* from Racine and states that it is a typical *arcticus.* The *subarcticus* of most authors (but not of Hoy) is renamed by him *pallescens.* This form has been credited to Wisconsin, probably through error in mistaking Hoy's *subarcticus* as the same bird as the *subarcticus* of later authors.

Intermediates are common in Wisconsin in winter, but Mr. Stone thinks they are more likely intermediates between *virginianus* and *arcticus* than between the former and *pallescens*. The western horned owl may, however, occasionally straggle to our southwestern borders.

Nyctea nyctea *(Linn.).* **SNOWY OWL.**

Winter visitant, of irregular occurrence. Some winters the snowy owl is quite common, straggling to the very southern portions in some numbers, and again not a specimen is recorded. A bird of the prairie and large marshes rather than of the thick woods, and consequently found more often along Lake Michigan and the Lake Superior shores than in the interior. Rev. A. C. Barry, 1854, speaks of it as frequently remaining in Wisconsin in summer, which is *very* doubtful even of that day. Thure Kumlien knew of two such cases, but the birds each time proved to be "cripples," having been slightly wounded and unable to return with the breaking of spring. Perfectly sound specimens were secured, however, in April on several occasions, and one as late as May 5 (1847). Frequently appears in southern Wisconsin as early as the middle of October, but more often from late November to mid-winter. Can hardly be considered as nocturnal, as it hunts over the marshes all day like a hawk. When these owls reach Lake Koshkonong during open water they persistently hunt along the edge of the rushes for wounded ducks, and at times, apparently from choice, as other food is plenty, will catch fish. Does not occur in nearly as great numbers as formerly, and at the present time has developed a degree of sagacity equalled only by the sand-hill crane or golden eagle.

Surnia ulula caparoch *(Müll.).* **AMERICAN HAWK OWL.**

A very rare winter visitant in southern Wisconsin; more frequent in the northern part, especially of late years. Recorded from Racine by Dr. Hoy and from the same place by Thure Kumlien, who received a specimen from there killed in the winter of 1869. Several were also taken about Lake Koshkonong at an early day. Mr. J. N. Clark has taken the hawk owl twice at Meridian, in April, 1885, and in December, 1900. In the winter of 1892 we received three specimens from Bayfield County. A specimen in the Milwaukee Public Museum is labeled "Fox Point, Milwaukee, Wis."

ORDER PSITTACI: PARROTS, MACAWS, PAROQUETS, ETC.

FAMILY PSITTACIDÆ: PARROTS AND PAROQUETS.

Conurus carolinensis *(Linn.).* **CAROLINA PAROQUET.**

Many years ago the paroquet occasionally wandered to southern Wisconsin. Dr. Hoy, in 1852, somewhat vaguely refers to it as "formerly common on the Mississippi River, within the state, latterly seldom met with." Thure Kumlien saw a considerable flock near Lake Koshkonong in 1844 or 1845. One specimen which he secured at this place at an early day was sent to John G. Bell, of New York. In the Kumlien collection is a fine specimen, taken in Waukesha County in 1844, which is probably the only Wisconsin specimen extant (1). Nelson, in 1876, refers to the taking of specimens in northeastern Illinois, by Robert Kennicott (probably in the fifties), and states that others were seen in the vicinity at an early day.

ORDER COCCYGES: CUCKOOS, ETC.

FAMILY CUCULIDÆ: CUCKOOS, ANIS, ETC.

Coccyzus americanus *(Linn.).* **YELLOW-BILLED CUCKOO.**

A regular summer resident from the southern tier of counties to at least beyond the middle of the state, and sparingly still farther north. Not nearly so common in most sections as the next, and rather irregularly distributed. In some districts it is even more common than the black-bill, this being especially true in parts of the extreme southern counties at least. It is a common occurrence to find young of different ages in the same nest, and even young nearly ready to fly and fresh eggs together. Appears to be more numerous than thirty-five years ago. A rather late arrival in spring—often not before the 20th of May—it departs for the south by the end of August. Often confounded with the next, which seems inexcusable.

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1. Cook's "Birds of Michigan," 1893, makes the mis-statement that I have taken a specimen of the paroquet in Jefferson County, Wisconsin. This probably refers to one taken by my father many years before, as I have of course, never seen the bird in the state.—L. Kumlien.

Coccyzus erythrophthalmus *(Wils.).* **BLACK-BILLED CUCKOO.**

A summer resident; rather hardier than the yellow-billed, arriving earlier and remaining later; more common than that species also and more regular in distribution. From data at our command this species seems to range much farther north than the preceding and not to be so closely restricted to certain localities and certain kinds of timber. We have watched a pair of these birds, returning from day to day, eat and carry away the hairy caterpillars as fast as they left the web nest, in a small wild plum tree. We have found the eggs of one of the species of cuckoo, at least, in nests of the catbird, brown thrasher and rose-breasted grosbeak, but have never seen the young cared for by foster parents.

FAMILY ALCEDINIDÆ: KINGFISHERS.

Ceryle alcyon *(Linn.).* **BELTED KINGFISHER.**

A common summer resident. Arrives in southern Wisconsin about the first of April, and remains until the ice forms. Mr. Wm. H. Bennetts writes us of an individual which remained through the winter. An interesting bird, whose life history has been but slightly touched upon. A careful study of the habits and every day doings of the kingfisher has many surprises in store for the careful observer.

ORDER PICI: WOODPECKERS, ETC.

FAMILY PICIDÆ: WOODPECKERS.

Dryobates villosus *(Linn.).* **HAIRY WOODPECKER.**

Resident, common, but not nearly as abundant as the downy woodpecker. Not particularly a bird of the pine timber, it breeds from the southern tier of counties northward in hardwood sections as well. Commoner in southern Wisconsin in winter.

Dryobates villosus leucomelas *(Bodd.).* **NORTHERN HAIRY WOODPECKER.**

Dr. Hoy and Thure Kumlien took specimens of this variety in the early days in both Racine and Jefferson Counties. Up to 1875 it was a regular visitor in winter in the tamarack swamps in north Jefferson County. During the past ten or fifteen years not a specimen has been taken and hairy woodpeckers collected in winter and late fall in northern Wisconsin have all proved to be typical ***villosus***. More information regarding its recent occurrence and distribution in Wisconsin is desirable. To be looked for in severe winters along our northern border, especially. The hoary whiteness is a more pronounced character even than the larger size.

Dryobates pubescens medianus *(Swains.).* **DOWNY WOODPECKER.**

Resident. Common at all seasons, but more plenty in summer than in winter, in this respect the opposite of ***villosus***. Fully as common as thirty years ago. Competent observers, as Grundtvig, in his "Birds of Shiocton," speak of this species nesting at heights of thirty feet or more. This is decidedly at variance with the habits of the bird in southern Wisconsin, where it is a common nesting species, the nest being rarely more than ten or twelve feet, often only four to six, and in one instance just twenty-six inches above the ground.

Picoides arcticus *((Swains.).* **ARCTIC THREE-TOED WOODPECKER.**

Common in the pine regions of the state during late fall and winter. Before the growth of heavy tamarack was cut in the many swamps of portions of southern Wisconsin it was abundant in such localities as far south as Fort Atkinson in winter. Rarely taken in other timber than pine or tamarack, and of late years it seldom visits southern Wisconsin. This species undoubtedly breeds in the northern part of the state, as there are several records of specimens taken during summer months. We have seen it at Merrill and near Wausau in June, and near Oconto (several specimens) in early August. Thirty to forty years ago it impressed one as being almost gregarious, such large numbers were found in a very small area of dead tamarack. These trees seem to contain insect larvæ of which the birds are particularly fond.

Picoides americanus *Brehm.* **AMERICAN THREE-TOED WOODPECKER.**

Rare winter visitant. Records of this woodpecker for Wisconsin are very few. From 1860 to 1870 several specimens, about a dozen all told, were taken by Thure and L. Kumlien in the large tamarack wood near Jefferson. Dr. H.

V. Ogden and Dr. E. Copeland have taken two specimens in Iron County, a male and a female, taken, respectively, Sept. 30 and Sept. 25, 1898, and preserved in the collection of E. Copeland and H. Russel at Milwaukee; and it has been reported from the upper peninsula of Michigan by Mr. H. Nehrling. It is certainly a decidedly rare bird in central or southern Wisconsin at the present day, but doubtless occurs each winter in the extreme northern pine woods.

Sphyrapicus varius *(Linn.)*. **YELLOW-BELLIED SAPSUCKER.**

Abundant migrant and regular summer resident. Arrives in southern Wisconsin from the last of March, through the month of April. In autumn the migration extends from September 15 to October 15. Summer resident from near the southern tier of counties northward, sparingly southward and more commonly farther north. Breeds in considerable numbers about Lake Koshkonong, always in "bottom land" timber, maple, elm and ash, usually, if not always, excavating a cavity in a green tree. Spring males show a great variation in the amount and distribution of the red, both on throat and head. Apparently has not decreased in numbers during the past thirty-five years.

Ceophlœus pileatus abieticola *Bangs*. **NORTHERN PILEATED WOODPECKER.**

With the disappearance of heavy timber this species has gradually been driven from sections where it was formerly common. Going back to 1870 and earlier, it was not at all an uncommon bird in Bark River woods in Jefferson County, where it bred regularly as late as 1872, and sparingly even later. No doubt the same thing is true of all the once heavily timbered sections of the state. One was shot in Jefferson county in 1877, in late fall, the last record for the section. One was seen in Walworth County in May, 1889. In the central and northern parts of the state it is still fairly common, especially in the heavily timbered hardwood districts. Probably resident whereever found, though individuals sometimes wander considerable distances out of their usual range. We received a specimen in October, 1898, which had been killed by a boy with a "slingshot" in Lincoln Park, Chicago. Several years ago a specimen was taken alive in a room of the upper story of a house in Milwaukee. It had apparently crawled in at the open window. Two specimens have been picked up on the lake shore at

Milwaukee, having no doubt become bewildered and perished in the lake. Generally known as "wood-cock," or "log-cock" by deer hunters and people living in the timber regions. Except in the entirely unsettled parts of the state has become exceedingly wild and wary.

Melanerpes erythrocephalus *(Linn.).* **RED-HEADED WOODPECKER.**

Very common summer resident and of late years to a considerable extent resident. Few birds have so modified their habits in the past forty years as this species. Twenty-five years ago it was a rare thing to find one in winter; at the present time that is a common occurrence. Perhaps more interesting are the curious nesting sites selected in order to conform to the changed surroundings. Instead of being restricted more or less to rather open groves of heavy timber it is now found almost everywhere, in the largest cities and on the widest prairies. Among some of the odd nesting sites we have noted are the following: Between two flat rails on an old style rail fence; the hub of a broken wagon wheel, leaning against a fence; the box of a grain drill left standing in a field; a hole excavated in the hollow cylinder of an ordinary pump; common in fence posts and telegraph poles. These were usually in prairie regions where there were few, if any, suitable trees. The red-head has to a marked degree the habit of the genus *Melanerpes* of hiding or hoarding food, acorns, corn, various nuts, etc., in cracks and crevices in the bark of trees, along fences, etc., but it does not always utilize these hoards.

Melanerpes carolinus *(Linn.).* **RED-BELLIED WOODPECKER.**

Not a common species anywhere in Wisconsin. Our observation has been that it inhabits heavy bottom land timber, maple, ash, etc., in preference to oak. Probably nearly resident wherever it occurs in the state, as it certainly is in Jefferson, Dane and Rock Counties, it being, if anything, more common in suitable localities here in winter than in summer. Dr. Hoy noted that it remained all winter at Racine. Grundtvig found it in winter in Outagamie County in 1883, and Willard took specimens in Brown County in February and April. Mr. J. N. Clark has procured but four specimens in sixteen years collecting in Dunn County—one male was seen in November. The eggs have been taken several times in Jefferson County, where the nesting sites were always in large dead trees overhanging water, and generally at a considerable height, and very hard to reach. Mr. W. E. Snyder records three specimens from Dodge County—in June, October, and November. We took a single specimen in Milwaukee County in May, 1882, but in no part of the state have we ever found it as plenty as along the bottom lands of Koshkonong Creek, Jefferson County.

Colaptes auratus luteus *Bangs.* **NORTHERN FLICKER.**

A very common summer resident in all parts of the state. This is especially true of the older settled sections. Arrives in southern Wisconsin from the middle of March to the first week in April, according to the season, and though the greater portion have left for the south by the middle of October, a few are found a full month later. Less common in the heavy pine regions. In sections where suitable trees are scarce, this species will sometimes bore a hole in the gable end of a clapboard house and deposit its eggs on the first convenient cross timber between the board and plaster. One instance which came to our notice was where an opening was made in the loft of a barn, and the eggs simply deposited on some hay in one corner, several feet from the hole. An ant-eating, ground-feeding species, very different in habits from the rest of the woodpeckers. We have taken two specimens in southern Wisconsin, which show a slight tendency toward the red-shafted. One male in the Kumlien collection, Milton, Wis., May 10, 1892, has a very liberal sprinkling of scarlet in the usual black "moustache," besides some minor intermediate characters.

ORDER MACROCHIRES: GOATSUCKERS, SWIFTS, ETC.

FAMILY CAPRIMULGIDÆ: GOATSUCKERS.

Antrostomus vociferus *(Wils.).* **WHIP-POOR-WILL.**

This bird was formerly a very common summer resident in all thickly wooded sections of the state, and is still locally common wherever there is thick underbrush, or in such places as have not been pastured or burned over. It usually arrives in southern Wisconsin from the first to the tenth of May, and leaves for the south early in September. Nearly all observers who have favored us with reports speak of its rapidly diminishing numbers, except in such sections as have been but slightly disturbed from a state of nature. Found the entire length of the state, but is generally more common in the hardwood districts than among the pines.

Chordeiles virginianus *(Gmel.).* **NIGHTHAWK.**

A common summer resident. The nighthawk is one of those species which have changed their habits to conform with the state of civilization. Thirty years ago a common breeder on any gravelly or sandy knoll or hill, often in cultivated fields and pastures, and even on the sandy shores of lakes. At the present time is as common in the towns as in the country, breeding on the flat roofs of buildings, even in the larger cities. The immense autumnal flights, formerly a regular feature of the fall migrations, are becoming less regular, and although still locally common, are a mere fraction of what they once were. Large numbers of these useful birds are yearly slaughtered by a certain class of "sportsmen" (?), for "practice." We are at a loss for words to express our supreme disgust at this abominable practice; still it is in perfect keeping with the average intelligence of many of this particular class, and we only hope that our feeble protest will be read by some "prominent" person who considers it legitimate sport to kill and main these exceedingly useful birds by the hundred. Not being "game birds" the game wardens are disposed to overlook this criminal practice, and thus the slaughter goes on from year to year.

Chordeiles virginianus henryi *(Cass.).* **WESTERN NIGHTHAWK.**

On returning from a visit to the Douglass Bros., at Waukegan, Illinois, at the time that Messrs. Nelson, Rice and Douglass (1) had firmly established the presence of *C. v. henryi* at that place, I found three specimens in the Kumlien collection. One of these, sent to Dr. Coues, was pronounced typical *henryi.* Two specimens were later secured by Thure Kumlien in September, 1880. Since that time we have not taken a specimen, the nearest approach being a few intermediates. Probably found as an irregular migrant, especially in fall, throughout western and southwestern Wisconsin, and possibly rarely as a breeding bird.—L. K.

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1. Nelson, Birds of N. E. Illinois, p. 114.

FAMILY MICROPODIDÆ: SWIFTS.

Chætura pelagica *(Linn.).* **CHIMNEY SWIFT.**

An abundant summer resident. The chimney "swallow" has been steadily increasing in numbers during the past fifty years. At the present time it nests almost entirely in chimneys, but in some sections still breeds in large hollow trees.

FAMILY TROCHILIDÆ: HUMMINGBIRDS.

Trochilus colubris *Linn.* **RUBY-THROATED HUMMINGBIRD.**

The little ruby-throat is a common summer resident in all suitable localities throughout the state. It arrives early in May, sometimes before it really should attempt to brave our climate, and numbers often perish from the late frosts. Some are already migrating by the last of August, but many linger until well along toward the last of September.

ORDER PASSERES: PERCHING BIRDS.

FAMILY TYRANNIDÆ: TYRANT FLYCATCHERS.

Muscivora forficata *(Gmel.).* **SCISSOR-TAILED FLYCATCHER.**

The only record of the occurrence of this bird in Wisconsin is that of the single adult male taken by L. Kumlien near Milton, Rock County, October 1, 1895. The bird was perched on a fence by the roadside, and was shot as it flew away. Although a cold, blustering day, it seemed entirely at ease, and was in perfect condition, being very fat. The specimen is preserved at Milton.

Tyrannus tyrannus *(Linn.).* **KINGBIRD.**

This familiar bird is an abundant summer resident from the last of April until early in September. First arrivals of different years in southern Wisconsin have been from April 20 to May 2, and the latest seen from August 26 to September 2. It nests from May 20 until late in June, often rearing two broods.

Tyrannus verticalis *Say.* **ARKANSAS KINGBIRD.**

An adult female of this species was shot near Albion, Dane County, June 11, 1877. It was apparently not breeding. The bird was perched on a fence by the roadside, and was shot under the impression that it was a great crested flycatcher, a species which the collector was anxious to secure. We are not aware of any other record of the capture of this bird in Wisconsin. The specimen is now preserved in the Museum of Milton College.

Myiarchus crinitus *(Linn.).* **CRESTED FLYCATCHER.**

The crested flycatcher is not an uncommon summer resident and regular breeder in most parts of the State. Grundtvig found it nesting in Outagamie County, and Mr. Clark reports it as a regular summer resident, but not abundant, in Dunn County. In the southern part of the state, about Delavan and Milton, it is a rather common species, nesting in the heavy timber. It appears from the south the second week in May, and departs early in autumn.

Sayornis phœbe *(Lath.).* **PHŒBE.**

Abundant summer resident. Adapting itself to the inroads of the summer visitors among its favorite breeding grounds, there is hardly a lake cottage which does not have its phœbe's nest under the veranda or eaves. The first of the flycatchers to arrive in the spring, we have noted it as early as March 19, and have found it abundant on March 30, though usually not so until the forepart of April. It remains with us until nearly October 1 (last dates, Delavan, September 20, 26, 30). Two broods are often reared, the nesting season commencing very early, and occupied nests are common up to July 1.

Sayornis saya *(Bonap.).* **SAY'S PHŒBE.**

Accidental straggler. The only authentic record that gives this species a place in the list is that of Dr. Hoy, who took at least one specimen at Racine. The actual date of capture seems to have been lost, and as the Hoy collection is now entirely without data we are unable to find it. Aside from our personal knowledge, of at least the one specimen, the record is given by Nelson, Grundtvig and King, the latter noting that "Dr. Brewer states that one specimen was obtained by Dr. Hoy near Racine, and sent to Mr. Cassin for identification" (1).

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1. F. H. King, "Economic Relations of Wis. Birds. Geol. of Wis., I, 1873-9. p. 560.

Contopus borealis *(Swains.).* **OLIVE-SIDED FLYCATCHER.**

Rather a rare but regular migrant. More common during the latter part of May than in the autumn, when it appears sparingly for a short time from the last of August on. Breeds along Lake Michigan from Sheboygan northward, and doubtless in other sections of the state. Specimens have been taken at Lake Koshkonong as late as June 10, often to June 2 and 3. We think this species is more common than generally supposed. When one has learned where to look for it, it can always be found during the migrations. Will usually be found on the topmost dead branch of a tree higher than the surrounding ones, from which elevated perch it constantly darts out, frequently to great distances, after insects.

Contopus virens *(Linn.).* **WOOD PEWEE.**

The most abundant and generally distributed of the flycatchers throughout the summer, nesting in almost every piece of woods. Arrives the last of April, or early in May (April 28 to May 5), and remains until late in September (last dates September 13, 20, 27, 28). It often rears at least two broods, nesting commencing the first of June, and young unable to fly may still be found in August.

Contopus richardsonii *(Swains.).* **WESTERN WOOD PEWEE.**

Rare, straggling summer resident. Several typical western wood pewees have been taken at Lake Koshkonong. One pair, with nest and eggs, were identified by Dr. Coues as unquestionably of this species. Not reported by other observers at any point in the state, and we can add nothing to the above bare facts. Doubtless careful watching will prove its presence rarely at other localities within our boundaries.

Empidonax flaviventris *Baird.* **YELLOW-BELLIED FLYCATCHER.**

Not as rare in Wisconsin as early writers have made us believe, the yellow-bellied flycatcher is a regular migrant and rare summer resident. A rather late arrival in the spring it is usually not present until May 15 to 30. Thure Kumlien took a nest with four eggs in the Bark River woods, Jefferson County, June 7, 1860, and two nests at a later date in 1863 and 1864. A nest was found by L. Kumlien in a tamarack swamp near Albion, Wisconsin, June 25, 1891. This nest contained two young just hatched, and one egg. Mr. F. H. King obtained a specimen at Worcester, July 26, 1876, which would lead one to believe that it bred in that locality, as it probably does, rarely, in other parts of the state.

Empidonax traillii *(Aud.).* **TRAILL'S FLYCATCHER.**

As Mr. Wm. Brewster suggests, this form is probably an uncommon or perhaps accidental visitor of Wisconsin during migrations. A specimen taken at Delavan, August 1, 1897, has been identified by Mr. Brewster as typical *traillii.* Perhaps occurs as a regular summer resident in parts of southern and southwestern Wisconsin, but more specimens of the group will be necessary to satisfactorily determine its range and abundance.

Empidonax traillii alnorum *Brewst.* **ALDER FLYCATCHER.**

A tolerably common summer resident. It arrives from the middle to the last of May, and is most conspicuous during late July and August in open, willowy marshes, often far from timber. Mr. Brewster has kindly examined our small series of this group and pronounces the birds of late May and June typical *alnorum*, suggesting that this is no doubt the breeding form. He writes that "it is interesting to find typical examples of the two forms in the same locality." As noted under the last, more specimens of the *traillii* group will have to be examined before an accurate knowledge of their respective abundance in Wisconsin can be expected.

Empidonax minimus *Baird.* **LEAST FLYCATCHER.**

An abundant summer resident over the entire state, and like the pewee, is found nesting during early and mid-summer in all suitable localities. It sometimes arrives as early as April 12, but not commonly until the first of May (April 30 to May 5), and all leave us in September. A constant associate of the redstart and red-eyed vireo in thick second-growth oak woods, especially in the vicinity of water.

FAMILY ALAUDIDÆ: LARKS.

Otocoris alpestris *(Linn.).* **HORNED LARK.**

Found on the prairies during winter, ofttimes in considerable numbers. The birds representing this race of the horned lark reach the southern part of the state late in fall, and leave us early in spring. We have never known anything approaching typical *alpestris* to have been taken in Wisconsin in summer. It does not occur anywhere, under our observation, except on the larger prairies, while *praticola* is found in almost any field or pasture, even when quite small and surrounded by woods. Usually found associated with the Lapland longspur, arriving and departing with the latter. It averages so much larger than the prairie horned lark as to be readily recognized.

Otocoris alpestris praticola *Hensh.* **PRAIRIE HORNED LARK.**

This is the common, resident horned lark of Wisconsin, and is an abundant breeding species in all suitable localities. Frequently nesting as early as the middle of March, two broods are reared in a season. Breeding birds from northwestern Wisconsin show a considerable variation from those of the southern part of the state. In extremely cold weather in midwinter this form sometimes almost wholly disappears for a very short time.

Otocoris alpestris hoyti *Bishop.* **HOYT'S HORNED LARK.**

We have long mistrusted *O. a. arenicola* Hensh. as an occasional late fall or winter visitor to Wisconsin, and since the publication of Mr. Oberholser's "Review of the Larks of the Genus Otocoris" (1) have carefully gone over our series from many parts of the state. We find, as a consequence, no less than three perfectly typical specimens of *O. a. hoyti*, all procured in winter in Rock County, from large flocks of *alpestris*. The birds are doubtless of rare, but regular occurrence as late fall stragglers in many open prairie sections of the state.

FAMILY CORVIDÆ: CROWS, JAYS, MAGPIES, ETC.

Pica pica hudsonica *(Sab.).* **AMERICAN MAGPIE.**

Rare winter visitant. The magpie was doubtless formerly of more frequent occurrence in Wisconsin than during recent years. Dr. Hoy states that two were shot at Caledonia in December, 1848, and one was obtained at Bailey's Harbor, on Lake Michigan, November 15, 1849, by a gentleman from Racine. Mr. J. N. Clark, of Meridian, writes us that one was captured in a trap in Dunn County in 1870, and that he himself saw one in the same locality, at close gun range, in February, 1884. In the winter of 1859-60, Thure Kumlien made a number of ineffectual attempts to shoot a specimen that came daily to feed on some hog offal, that had been hung upon a neighbors

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1. Proc. U. S. Nat. Mus., XXIV, pp. 801-884.

fence when butchering. He saw the bird plainly on two or three occasions when he did not have a gun. This was in Jefferson County. A specimen was also taken near Ashland in 1880. Deer hunters from northern Wisconsin report seeing specimens, but very rarely. During severe winters they are sometimes seen about lumber camps. A pine-land hunter, with whom we were acquainted, said he had seen perhaps a half dozen in all his experience of many years in northern Wisconsin.

Cyanocitta cristata *(Linn.)*. **BLUE JAY.**

Abundant throughout the entire year over the greater part of the state. One of the most familiar of birds; as much at home in towns and cities, as in the deepest woods. More common in the settled portions of the south and central parts of the state than in the pine region.

Perisoreus canadensis *(Linn.)*. **CANADA JAY.**

Common and very familiar about the logging camps of northern Wisconsin during winter. Apparently does not extend its migration far outside of the pine regions, especially at the present time. It has been taken at Racine (Hoy), near Jefferson (T. Kumlien), and Janesville, but many years ago. There does not seem to be very good evidence that it is a summer resident in any part of the state; still it would not be at all surprising if it should be found nesting. Commonly known as "Whiskey Jack," and "camp-robber."

Corvus corax principalis *Ridgw.* **NORTHERN RAVEN.**

Steadily decreasing in numbers, but yet rather a common species in the less settled portions of northern Wisconsin. Dr. Hoy, in 1852, gave it as more numerous than the next at Racine. It has always been considered as more common along Lake Michigan than in the interior, except in the northern part of the state. Nelson found it a rare winter visitant in northeastern Illinois in 1876, but states that it was formerly "not an uncommon resident." King gives it as "common the whole length of the Flambeau River, October and November, 1877, several seen daily." Willard reports but one specimen from Brown County, and Gruntvig one from Outagamie County, in 1882. Grundtvig, on the authority of residents, states that it was formerly common in that county. Thirty to forty years ago the raven was not a rare winter visitant to southern

Wisconsin, but of late years it is rarely seen. A single specimen shot at Lake Koshkonong, November, 1891, by L. Kumlien, and mounted for Albion Academy, is the last real record we have, although others have been "seen." We have met it at several points in northern Wisconsin in late fall and winter, but more often along Lake Michigan and Lake Superior than elsewhere. It is really common at several points along Lake Superior, where it seems to replace the crow entirely. It is commonly found around the lake fishing stations.

Corvus americanus *Aud.* **AMERICAN CROW.**

Very abundant in the southern part of the state, it has gained in numbers at a wonderful rate, especially during the past fifteen years, notwithstanding the incessant warfare that has been carried on against it by the farmers and sportsmen. Indeed, the crow was formerly considered as not a common bird at all in southern Wisconsin, and the increase has been constant to a certain extent for the past fifty years. Dr. Hoy, in 1852, considered it one of the rarest of birds about Racine. At the present time it is not as common along Lake Michigan as in the interior, but is much more abundant than formerly. In north and north-central Wisconsin the crow is not a winter resident, though it is apparently extending the line farther and farther each year. At Stevens Point, for instance, it is migratory, and a common summer resident. Mr. Clark writes that in Dunn County it has become an abundant summer resident, and is more of a pest to the poultry raisers each year. A few winter here, Mr. Clark states. In the southern counties it nests early in April, and remains, in increased numbers, during the winter, forming immense roosts at intervals. At dusk it flocks in great numbers from miles around to these winter "crow roosts," leaving again in every direction, for the feeding grounds, at break of day.

Nucifraga columbiana *(Wils.).* **CLARKE'S NUTCRACKER.**

A specimen of Clarke's crow was shot by Mr. Hawley, in the western outskirts of Milwaukee in the late fall of 1875. The bird was too badly shot to make a good skin and it came into the possession of Dr. G. W. Peckham, who made a skeleton of it himself. The specimen, with the exact date, etc., was later destroyed by the disastrous high school fire in that city, in which Dr. Peckham lost his entire valuable osteological collection. There is not, however, the slightest possible doubt of the authenticity of the record; it is well remembered by our older ornithologists, and Dr. Peckham vouches for it himself.

FAMILY ICTERIDÆ: BLACKBIRDS, ORIOLES, ETC.

Dolichonyx oryzivorus *(Linn.).* **BOBOLINK.**

An abundant summer resident, arriving the first of May, and breeding in large numbers in all suitable places. One of the first of the summer visitors to leave us in the autumn, and all are often gone by the 20th of August, but in exceptional years it is common as late as that date in September, and has been taken even later. These tardy birds, however, appear to be migrants from farther north, and not the ones which nest with us. The first arrivals in spring are still partially in the winter plumage, and all have fully acquired this dress before again leaving in the fall.

Molothrus ater *(Bodd.).* **COWBIRD.**

Unfortunately for many of the nesting birds, particularly vireos, warblers and native sparrows, the cowbird is a common summer resident, and well indeed must their nests be hidden if they are to be safe from the alien egg. The list of species imposed upon is a very long one, in fact no variety, unless it be much larger or of entirely different habits, seems to be exempt. It arrives early in April, and departs, usually, in August. The cowbird is, without question, increasing steadily in numbers.

Xanthocephalus xanthocephalus *(Bonap.).* **YELLOW-HEADED BLACKBIRD.**

A summer resident. In some sections of the state the yellow-head seems to be totally absent, while on certain lakes it breeds abundantly. The species is apparently becoming more common in many localities where it was once almost unknown.

Agelaius phœniceus *(Linn.).* **RED-WINGED BLACKBIRD.**

A very abundant summer resident. One of the first birds to arrive in the spring, it remains until extreme cold weather—a few even wintering in mild seasons—in southern Wisconsin. Nests in all low places, weaving the nest in the grass, placing it on a bog, bush or even in a low tree. It begins flocking from August 10 to 20, and at this time becomes very destructive to corn in the milk, entire fields being sometimes ruined when situated near a lake or marsh. From the time the red-wing begins to flock until it leaves for the south, it invariably roosts in the reedy marshes, toward which localities it returns in great numbers about sunset. Albinistic specimens are common and we have seen two or three specimens with a pink crescent on the breast, as well as an adult male with no red on wings. It is very variable in size, and a large series of fall migrants, especially, would probably produce specimens of ***Agelaius p. fortis*** Ridgw., the thick-billed red-wing. It has not appreciably decreased in numbers during the past forty years.

Sturnella magna *(Linn.)*. **MEADOWLARK.**

An abundant summer resident, it is occasionally found at any time of the year, even in the severest of winter weather. Not so plenty in southern Wisconsin as thirty-five years ago. Many are shot by would-be sportsmen, and suitable nesting sites are fewer and restricted in size. For nesting grounds the birds prefer the virgin sod to cultivated fields. In Dunn County, Mr. J. N. Clark tells us, it appears to be giving way in numbers to the western form, ***neglecta***, which is slowly increasing in that region.

Sturnella neglecta *Aud.* **WESTERN MEADOWLARK.**

In many parts of the state the western meadowlark breeds more or less commonly. Dr. Hoy had a specimen, identified by Baird, which he captured at Racine as late as December 24. He also mentions its occurrence on the lake shore at other times in early winter. Mr. F. H. King found it breeding in St. Croix County (1). In Dunn County it is a regular summer resident and breeds. As stated under the preceding it is slowly increasing in numbers there. Mr. H. Russel, and Drs. Copeland and Ogden have found it in Milwaukee County. It is found regularly in Rock, Jefferson and Dane counties, but only (?) in very late fall, November and even December, not having as yet been noted in spring or summer.

Icterus spurius *(Linn.)*. **ORCHARD ORIOLE.**

In the southern part of the state this oriole is a regular, and not a rare summer resident, more often nesting in and on the edges of towns, in quiet places, than in the country. Mr. Clark finds it a common breeding bird in Dunn County, and writes

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1. Econ. Rel. Wis. Birds, Geol. of Wis., 1883.

that two pairs nest every year in his yard. The bird is certainly more common in southern Wisconsin than formerly, and sometimes even reaches the shores of Lake Superior. We cannot resist venturing the opinion that this species has gradually extended its summer home northward.

Icterus galbula *(Linn.).* **BALTIMORE ORIOLE.**

A common, or sometimes almost abundant summer resident, the "golden oriole," or "hang nest" is known to everyone as one of our handsomest village birds. It nests anywhere in the larger trees along the streets and about the lawns of our towns, and even in the country seems to prefer the immediate neighborhood of a farm house as a place to build its nest. One male was known to return to the Kumlien homestead five years in succession, with a mate, and build its nest on the same limb each year. This bird was accustomed to answer a certain note on the flute, and seemed happy to try and imitate different flute notes. It is not our purpose to go into details in regard to habits of birds, but the Baltimore oriole certainly possesses more "brains" than any other of our native species, as numerous instances we could cite would show. We have yearly been in the habit of furnishing the nesting materials for birds breeding about the house, and have varied the material until we have a collection of nests of many different fibrous substances.

Scolecophagus carolinus *(Müll.).* **RUSTY BLACKBIRD.**

An abundant migrant. This hardy species now pushes farther north to nest, and, returning late, is one of the last of the transients to leave us, remaining until the ice forms, and the sloughs freeze for the winter. Dr. Hoy writes of a few remaining through the summer (1852). Formerly quite a number were summer residents in southern Wisconsin even, but only a single instance of its nesting is on record. A set, nest and eggs, taken at Storrs' Lake, near Milton, June, 1861, is now in the Kumlien collection. We have several times seen specimens of either this species or the next in the western and northwestern part of the state in summer, but as they were observed from the car windows it is not safe to say which they were.

Scolecophagus cyanocephalus *(Wagl.).* **BREWER'S BLACKBIRD.**

Wisconsin is probably the extreme eastern limit of the breeding range of this species, and the only known instance of its nesting in the state was at Lake Koshkonong, June 14,

1862. Two or three specimens, besides these, have been taken at the same locality in the past sixty years. No doubt of more regular occurernce in the western part of the state. It is easily overlooked among the great numbers of the foregoing species; in fact all the specimens taken, excepting the breeding birds, were procured by accident in flocks of *carolinus.* King (1) says "met with rarely in the eastern portion of the state, but as it occurs regularly in Minnesota it may be found along the Mississippi." He procured a "single mature male, in July, on a large marsh just east of Princeton, Green Lake County." Nelson records it as "a rare visitant in company with the preceding," in northeastern Illinois in 1876.

Quiscalus quiscula æneus *(Ridgw.).* **BRONZED GRACKLE.**

An abundant summer resident. The "crow blackbird" arrives early, and nests throughout most of the state. It flocks in the summer as soon as the young are able to fly, and deserts its nesting grounds for the orchards and fields. Remains until late in the fall, often, in small numbers, until late in November. Of late years the grackle has taken to nesting in parks of cities and villages, and in the larger private grounds, until it is a prominent feature about our towns. Away from the towns it sometimes nests in cavities in trees, constructing a complete nest, however, in these holes. It readily takes to a large, deep box in a tree for a nesting site.

FAMILY FRINGILLIDÆ: FINCHES.

Hesperiphona vespertina *(Coop.).* **EVENING GROSBECK.**

A common winter visitant, usually found in good numbers any time from December on. Most frequent, however, during the latter part of the winter, in February and March, and sometimes remaining in the vicinity of favorite feeding trees until late in the spring. It has been taken in Jefferson County as late as May 20 (1891), and Dr. Hoy notes it for Racine as late as May 15. In the northern counties it is, of course, much more abundant, and although formerly very erratic and uncertain is of late years a regular winter resident. Different observers have for the past twenty-five years given their observations on this species until the subject is almost exhausted. Unquestionably the bird has gradually extended its usual range

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1. Geol. Wis., 1873-79, p. 551.

eastward and southward, until at the present time it is anything but rare in southern Wisconsin, where thirty to forty years ago it was almost unknown.

Pinicola enucleator leucura *(Müll.).* **CANADIAN PINE GROSBEAK.**

The pine grosbeak is a common winter bird in northern Wisconsin, and at irregular intervals it pushes its way to the southern counties, sometimes in good numbers wherever there are plenty of its favorite buds and berries. It is often supposed, and usually so written, that the appearance of this and the last species in the southern part of the state depends entirely on the severity of the weather; but this does not always seem to be the case as they are almost as frequently seen after prolonged spells of mild weather throughout the state as after an unusually cold snap, or a series of storms. Like the evening grosbeak, this species is much more regular and common every winter than during former years. It is said to nest within the boundaries of the state; but we are unable to substantiate this and think it very doubtful.

Carpodacus purpureus *(Gmel.).* **PURPLE FINCH.**

In most sections of southern Wisconsin a more or less common migrant in spring and fall, but very irregular in its occurrence. Dr. Hoy speaks of a few nesting about Racine fifty years ago. It has been known to remain through the summer in Jefferson County, but nests were not found. Grundtvig (1) found it nesting in Outagamie County in 1883, several pairs being noted. Mr. J. N. Clark states that the purple finch is "a regular migrant in Dunn County, but have never seen it in summer." He thinks it very doubtful if it nests in that part of the state. Noted at Delavan only as an irregular spring and fall migrant. We have seen it at Milwaukee, Two Rivers, Sturgeon Bay and Merrill in summer, where it was no doubt nesting. Dr. Hoy speaks of its nesting on Lake Superior, and we have evidence to show it to be a summer resident in Iron County. Apparently very erratic, not only as regards migration, but also in selection of summer homes.

Loxia curvirostra minor *(Brehm.).* **AMERICAN CROSSBILL.**

A regular and sometimes very abundant winter visitant in all parts of the state, though in some seasons not at all common

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1. Birds of Shiocton, Trans. Wis. Acad. Sciences. Arts, and Let. X-p. 126.

in southern Wisconsin. Nests irregularly in the north central parts of the state, and formerly as far south as Dane County. Young just able to fly were procured in a cemetery at Albion in August, 1869. Ofttimes remains about Stevens Point until well into summer. We have met it at various points in northern Wisconsin in summer and have procured young, barely fledged, in April in Iron County. Of a considerable number of Wisconsin crossbills sent Mr. Wm. Brewster for examination, a large percentage of the northern specimens were identified as *Loxia c. bendirei* Ridgw., and some specimens from southern Wisconsin (Walworth County) were determined as nearer *bendirei* than *minor*.

Loxia leucoptera *Gmel.* **WHITE-WINGED CROSSBILL.**

A winter visitant. This species is often common in north and central Wisconsin, and irregular flights have been noted at different points in the southern counties for the past fifty years. Mr. Clark writes that in Dunn County it is sometimes found with the common crossbill, but more often keeps in small flocks of its own kind only.

Acanthis hornemannii exilipes *(Coues).* **HOARY REDPOLL.**

An irregular winter visitor; rare. During January, February and March, 1896, Mr. J. N. Clark found these birds tolerably common in Dunn County. He writes: "In the winter named we had an unusual flight of redpolls from the first of November until late in March, but the hoary did not appear until January. They were nearly all found in one small field, situated at the top of a high hill, and well covered with pig-weed, upon which they fed. They were in small flocks, accompanied by a few of the common variety. I took over thirty specimens of *exilipes* during the three months." Mr. Clark has kindly sent us a series of redpolls from his locality for examination. Dr. Hoy noted but a single instance of their occurrence at Racine (December, 1850), but Thure Kumlien recognized them as distinct as far back as 1848, and took them a number of times during severe winters at Lake Koshkonong, where they have been taken at different times since. The last record for Rock County was in January, 1895. Specimens have also been received from Iron County and Shawano. They may be readily recognized in flocks of *linaria* by their lighter color.

Acanthis linaria *(Linn.).* **REDPOLL.**

An abundant winter visitant. In the southern part of the state the redpoll, like others of the northern birds which appear only in winter, is of irregular and uncertain occurrence, though usually found in good numbers at different times during the season. In the northern counties it is almost always an abundant visitor from late fall until spring, and seems to be especially plenty at certain localities, as about Stevens Point. Has been noted in Jefferson County as early as October 28 (1869). The early arrivals are always young birds, the full plumaged adults not becoming numerous until cold weather.

Acanthis linaria holbœllii *(Brehm.).* **HOLBŒLL'S REDPOLL.**

A rare winter straggler. One specimen was shot at Lake Koshkonong, January 22, 1867 (L. K.), and identified by Prof. Baird in 1881. In a series of redpolls taken during January, February and March, 1896, by Mr. J. N. Clark at Meridian, are four specimens easily referable to this race. Mr. Clark has kindly sent one of these to us for examination, which has been marked as *holbœllii* by Ridgway and Fisher, who identified a number of redpolls for him at the time. These specimens were taken singly during the three months from flocks of the other varieties. The difference can be readily seen when compared with a series of *linaria* and *rostrata* without measurements, and the very pronounced slender bill and robust size, as well as other characters, distinguish this from both the other races.

Acanthis linaria rostrata *(Coues).* **GREATER REDPOLL.**

Winter visitant. Mr. Clark collected over thirty of these birds in Dunn County during the winter of 1895-6. Regarding this variety he writes: "The greater redpolls kept, as a rule, in small flocks by themselves, accompanied by a few of the common ones only, and were nearly always found in the low timber lands along the river bottoms. Their food appeared to be the seeds of the water pepper almost exclusively." A series sent us by Mr. Clark at the time, in the flesh, all proved to be of this variety, and specimens of this and the other races were identified for him later by Prof. Robert Ridgway. Specimens have also been received from Stevens Point and Iron County, and others have been taken quite regularly at Lake Koshkonong, especially during winters of heavy snowfall. Here they have never been found except as associated with *linaria.*

Astragalinus tristis *(Linn.).* **AMERICAN GOLDFINCH.**

The goldfinch is an abundant summer resident, and is found in fair numbers at any time during the winter. It is more numerous during the spring migration, in May, however, than at any other time. It nests commonly in mid-summer, and even as late as September.

Spinus pinus *(Wils.).* **PINE SISKIN.**

Of very erratic occurrence in southern Wisconsin, it is most common during early autumn. Usually quite common about Lake Koshkonong at this season and has been noted here and at Delavan a number of times in spring. Much more common in the northern part of the state, abundant at times in some sections. Dr. Hoy supposed it to nest in the pine regions, which may be true. Grundtvig says: "Was certainly seen in flocks April 7, 1883, and the following days. None shot (Outagamie County). It is said to breed in Wisconsin as far south as Jefferson County (Cooke). Many were shot at De Pere in March, 1883 (Willard)." Mr. J. N. Clark has taken it only in October and November in Dunn County, and considers it a very unusual bird there. King says: "Ordinarily it is only a winter resident. A few may breed in the state." Personally we have never taken it in the state in summer.

Passer domesticus *(Linn.).* **HOUSE SPARROW.**

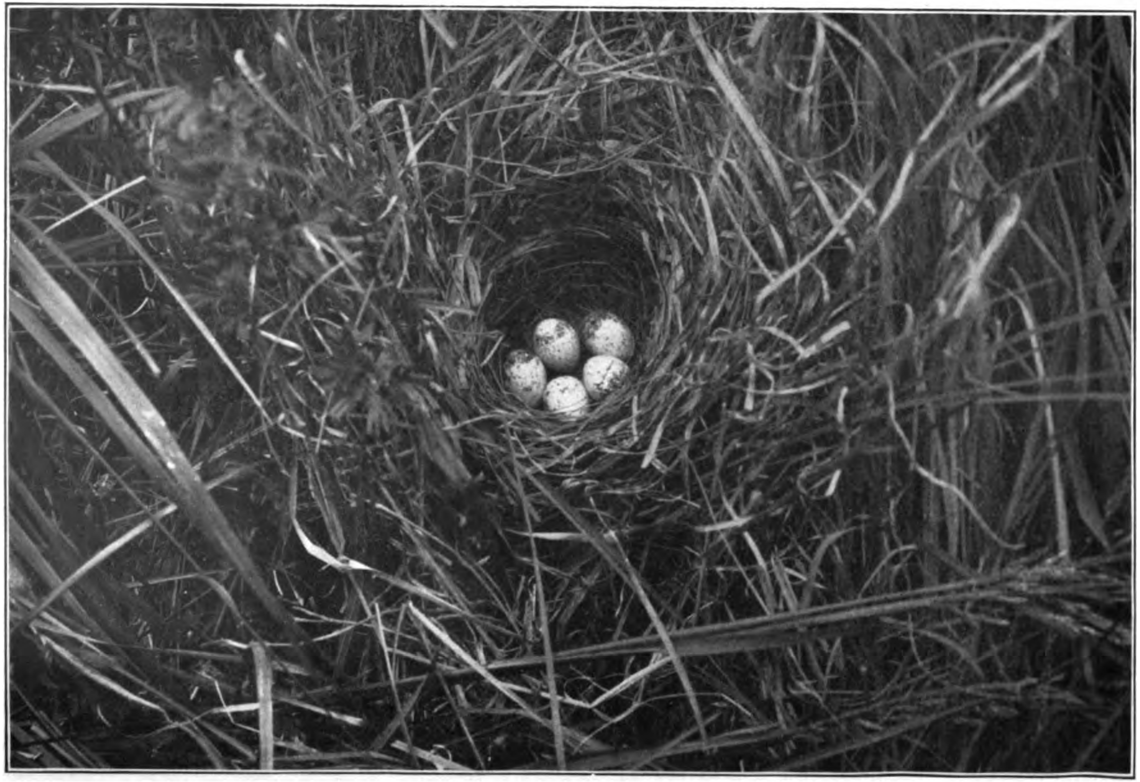
Abundant resident. Introduced, and has spread over nearly the entire state.

Passerina nivalis *(Linn.).* **SNOWFLAKE.**

A regular winter visitant, sometimes appearing in great numbers, at any time from October on until spring. Its favorite resorts are open fields, prairies, and lake shores, alighting on the beaches and bars, and running about like flocks of sandpipers. The first arrivals are always the young birds, the adults not taken until later. Full plumaged winter adults are not often taken in southern Wisconsin. For some reason not apparent it is much less numerous than formerly. Less severe winters and a lighter snow fall may be the sole reasons.

Calcarius lapponicus *(Linn.).* **LAPLAND LONGSPUR.**

A regular and abundant winter bird, ecpecially on the prairies. It arrives earlier in the fall and remains much later in the spring than the snowflake, with which it is often associated in winter. The longspur is in breeding plumage and full song



NEST AND EGGS OF HENSLOW'S SPARROW.

Photo. by F. E. BURROWS.

before it leaves southern Wisconsin in May. Often taken as late as May 10, and even May 16. We have one adult male shot on Rock Prairie, Rock County, on June 2. It is fully as common as thirty years ago.

Calcarius pictus *(Swains.).* **SMITH'S LONGSPUR.**

This longspur cannot be classed otherwise than as rare and of extremely erratic occurrence in Wisconsin. Dr. Hoy met with considerable numbers prior to 1852. Although we have looked for it very carefully on the prairies among the common longspurs we have found it but a few times, and never in flocks of any size. Presumably the migration is from the northwest and they merely cross the southern counties of Wisconsin in fall, as they are not at all rare on the prairies of Illinois in winter.

Poœcetes gramineus *(Gmel.).* **VESPER SPARROW.**

The vester sparrow is one of the most abundant of roadside birds the entire summer, nesting wherever there is sufficient grass to cover its eggs. It arrives the first of April, and for a short time is found, as often in the south, in the woods, but on the approach of the nesting season it forsakes the trees for the open fields and pastures.

Passerculus sandwichensis savanna *(Wils.).* **SAVANNA SPARROW.**

An abundant summer resident. Arrives early in April, and is common by the latter half of the month. Nests on the dry marshes and prairies, but in the fall is a common bird about the ponds and lakes, in flocks, spending much time among the rushes, over shallow water.

Coturniculus savannarum passerinus *(Wils.).* **GRASSHOPPER SPARROW.**

Common summer resident over most of the state. Like some others of the genus the grasshopper sparrow appears to nest in scattered colonies. In the breeding season one may go for miles without seeing an individual of the species, and then suddenly find it abundant, a male on nearly every fence post.

Ammodramus henslowii *(Aud.).* **HENSLOW'S SPARROW.**

Until recently our only knowledge of the occurrence of this seclusive species in the state was based on the capture of six specimens near Milton. The first of these, a male, was taken in the fall, about 1870; two in September, 1892; and three during September, 1894. On May 29, 1897, we were together collecting on a large, dry marsh near Delavan, and found it abundant and evidently nesting. Many specimens were taken in all stages of plumage during the summer and fall, and each succeeding year we have found it equally abundant; but although we have taken many young still unable to fly more than a few feet and yet in nestling feather, as well as specimens in the post-juvenal moult, we have been able to find but one nest. This was taken May 29, 1898, and contained five eggs. It was placed on the ground in a tuft of grass beside some small willows, within twenty-five feet of a clump of tamarack trees, in one of the dampest places on the marsh. The parent bird was shot as she flew from the nest. The birds seem to remain on this marsh entirely, at least we have never found them anywhere else at any season, except as noted above. They arrive in May, and remain until well into October. During the latter part of August and September the adults especially are in a condition of such extreme moult as to be almost unable to fly, there being many days when not an individual can boast of even a single tail feather. At the height of the nesting season, in June and early July, the males are perched upon the tops of the higher weeds over the whole marsh, but at other times of the year they must almost invariably be flushed from the grass to be seen. Evidently two broods at least are reared as we have, by the aid of a careful retriever, taken nestlings in September. Mr. W. E. Snyder has recently discovered the species about Beaver Dam, and states that it is "an abundant summer resident in the dryer marshes" (1). It will doubtless be found in many localities in southern Wisconsin, where there are suitable breeding grounds.

Ammodramus leconteii *(Aud.).* **LECONTE'S SPARROW.**

This species was taken at Lake Koshkonong but three or four times, but always in autumn, from 1842 to 1890 (T. and L. K.). One specimen was taken near Milwaukee in the fall of 1879 (L. K.). In September, 1894, numbers were procured at Lake Koshkonong, and at the same date in 1895 five hundred could have been taken. In 1896 but few were seen, and in 1897 none were procured. Since 1897 but a few each fall could be found. One was taken at Delavan in September,

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1. Bull. Wis. Nat. His. Soc., April, 1892, p. 111.

1900, and others noted. We are at a loss to account for its great numbers in 1895, when a series of sixty skins was secured in two days, and as many more could have been easily taken. It is also rather remarkable that the closest search has failed to produce a single specimen in spring, none having been noted before August. Precisely similar localities to those frequented at Lake Koshkonong have been carefully searched, with a good dog, but without success. One of the most difficult birds imaginable to collect, as it is never seen until flushed, must be shot on the wing, and last, but not least, *found*, after it is killed.

Ammodramus nelsoni *(Allen).* **NELSON'S SPARROW.**

For the past twelve years we have found this species exceedingly abundant about Lake Koshkonong, in September and early October. Here it is always found among the bullrushes growing in the water. Several were noted near Delavan Lake, September 26, 1899, and one taken, by F. E. Burrows. King records one specimen from Cold Spring Pond, Jefferson County, September 7, 1877, and Dr. Hoy took at least one at Racine. Although so very common in fall about Lake Koshkonong we have been unable, as in the case of *leconteii*, to find a specimen in spring or summer. Curiously enough this bird was not detected by Thure Kumlien and others in Wisconsin in early days, and what strikes the writers as still more peculiar is that the same localities where it is now so abundant were *carefully* observed twenty to thirty years ago without finding a single individual of the species. It seems almost impossible that it could have been overlooked, if as abundant at that time as at the present day.

Chondestes grammacus *(Say).* **LARK SPARROW.**

This superb songster is somewhat irregularly distributed in Wisconsin. In most of the less wooded sections of the central and southern part it is a fairly common summer resident, but seems to be entirely absent from some localities. Mr. Clark finds it a common nesting species in Dunn County. Dr. H. V. Ogden and Mr. H. Russel have found it in fair numbers near Milwaukee. Dr. Hoy called it common at Racine, fifty years ago. Formerly quite common about Lake Koshkonong, but of late years has greatly decreased in numbers. The lark sparrow loves the uncultivated sod. Wherever there is an unbroken prairie, if only of limited extent, it is sure to be found.

Much more common in the western, than in the eastern part of the state. In settled districts a frequenter of the roadside, and especially liable to be found in old, grass-grown orchards.

Zonotrichia querula *(Nutt.).* **HARRIS'S SPARROW.**

Apparently, this bird is becoming more common in Wisconsin than formerly. Mr. J. N. Clark, of Meridian, Dunn County, gives us the most information regarding its occurrence in the state. Some years ago he wrote us as follows: "The first that came to my notice in Wisconsin were taken May 12, 1886, a pair, and I saw no more until October 5, 1890, when three specimens were taken from a bunch of four, and again, October 19, 1892, saw a flock of six or eight, and have seen a few individuals each fall since, but never have found it in the spring, except the time mentioned above. It is a rare bird in this locality, but is becoming more plenty each year." Recently, Mr. Clark wrote again, in answer to our inquiries, that he has found it nearly every fall and spring for the past few years, and has seen it as late as June 1. "It is becoming more common every year," he again states. Still later, the past year, Mr. Clark noted a pair of these birds at Meridian on the morning of July 4 (1902), "near the bank of a wooded stream." "From their actions," he writes, "and the lateness of the season, I think there is not much doubt but that they were nesting near by, but I had not the time then to look for the nest." Dr. Ogden and party found this species in Iron County, taking a specimen from a flock of about twenty-four birds. There is also an old record of Dr. Hoy's of one specimen taken at Racine, and W. W. Cooke (1) mentions a specimen captured at Trempealeau in the fall of 1883. Three specimens have been taken at Lake Koshkonong, one in spring, and two in fall.

Zonotrichia leucophrys *(Forst.).* **WHITE-CROWNED SPARROW.**

The white-crown is a common migrant, usually in the scattered flocks of white-throats, fox, and other hedge and brush-loving sparrows. It also *nests* very sparingly in the state. Dr. Hoy reported that a few nested near Racine. It was also taken nesting at Cedarburg in June 1882, when two of the five young, barely able to fly, were taken. In 1873 it nested on the north shore of Lake Monona, at Madison, and it has been known to remain through the summer, a number of times, at Lake Koshkonong.

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1. Auk, I, 4, p. 333.

Zonotrichia leucophrys gambelii *(Nutt.).* **INTERMEDIATE SPARROW.**

Rare straggler. A specimen of this variety was taken at Racine, April 20, 1871, by Dr. P. R. Hoy. Specimens have been taken a number of times about Lake Koshkonong which are almost, if not quite, typical *gambelii.* Regarding the Hoy specimen Mr. Nelson (1) says: "The specimen has been kindly loaned me for examination, and is without doubt a perfectly authentic example of the variety. The lores are almost white, considerably lighter than in the average specimen of *intermedia*" (=*gambelii*).

Zonotrichia coronata *(Pall.).* **GOLDEN-CROWNED SPARROW.**

Rare straggler. Several specimens of this western bird were taken by Dr. Hoy near Racine, from 1853 to 1858, both spring and fall. Mr. E. W. Nelson states (Birds of Northeastern Illinois) that he examined one of these, a fine male taken during April, 1858, which had been previously identified by Mr. Cassin.

Zonotrichia albicollis *(Gmel.).* **WHITE-THROATED SPARROW.**

An abundant migrant, and in parts of the state a common summer resident. Nests sparingly even in the most southern counties, but more commonly in the central and northern portions of the state. It seems restricted during the breeding season to favorite localities, where several pairs will be found nesting within a very limited area.

Spizella monticola *(Gmel.).* **TREE SPARROW.**

Abundant migrant and common winter resident. Commonly flocks with the juncos along the brushy roadsides, and often invades the cities and towns, in cold weather, in search of food. March and April, and, later, October and November are the months when it reaches its greatest abundance.

Spizella socialis *(Wils.).* **CHIPPING SPARROW.**

Common summer resident. Before the days of the English sparrow the chippy was an abundant village bird, nesting in almost every yard. Now all is changed, and in most towns it is a rare occurrence for a pair to settle for the summer where it was formerly common. It is still plenty, however, in the country, where it prefers the immediate vicinity of a farm house to the more retired wood.

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1. Birds of Northeastern Illinois, Bull. Essex Inst., VIII. 107.

Spizella pallida *(Swains.).* **CLAY-COLORED SPARROW.**

An irregularly distributed summer resident, from the southern part of the state northward. From the meager records at hand it seems to be more common in the western part of the state than farther east. Appears to frequent barren, dry and wild places, in marked contrast to *socialis* and *pusilla*. Has been taken nesting at Lake Koshkonong, where it occurs as a regular summer resident. More common about Stevens Point than any other locality we know of. Specimens from the sandy pine barrens of Portage County are so different from true *pallida* that Mr. Wm. Brewster thinks they may prove a new race. The lack of a sufficient number of specimens at the present time makes it impossible to settle this point. These specimens are almost as dark as a swamp sparrow.

Spizella pusilla *(Wils.).* **FIELD SPARROW.**

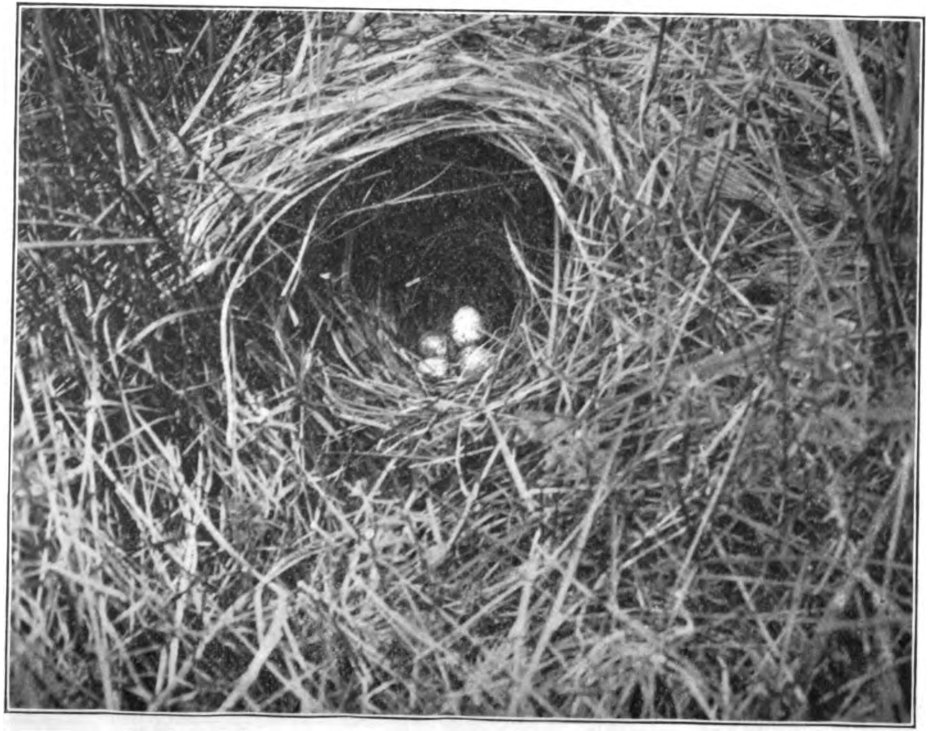
In all suitable places—and these are anywhere that there is a sufficient mixture of brush and open—the field sparrow is an abundant summer bird. Arriving early, remaining late, and rearing two, if not three broods each season, it is one of the most characteristic birds of the woodland border, the open clearings, and the edges of fields.

Junco hyemalis *(Linn.).* **SLATE-COLORED JUNCO.**

A very abundant migrant and common winter resident. Nests sparingly in northern Wisconsin Three sets were taken at Oconto, in May, 1882 (Coll. of L. K.). The nests were placed on the ground, among sphagnum moss. Dr. Hoy mentions its breeding on the shores of Lake Superior. In rare instances the junco breeds in southern Wisconsin. Young, barely able to fly, have been taken near Jefferson, which is the most southern point for which we have any record, and this must be taken only as an exceptional case.

Junco montanus *Ridgw.* **MONTANA JUNCO.**

A single female of this species was taken at Delavan, October 23, 1898, and is now in the Hollister collection. Mr. Wm. Brewster, who has kindly examined the skin, writes: "This bird matches perfectly a specimen in my collection from Illinois, identified by Mr. Ridgway as typical *montanus*." Doubtless occurs as a straggling migrant any where in southern



NEST AND EGGS OF SONG SPARROW.

Photo. by F. E. BURROWS.

Wisconsin. The various old records of *Junco oreyonus*, *J. o. shufeldti*, *J. h. connectens*, etc., probably belong here.

Melospiza cinerea melodia *(Wils.).* **SONG SPARROW.**

Summer resident. The song sparrow arrives in March, and until late in the fall is an abundant bird. Nests almost anywhere and everywhere, though preferring the immediate vicinity of some creek or spring, where the ground is damp or wet. Specimens have been taken in southern Wisconsin in mid-winter.

Melospiza lincolnii *(Aud.).* **LINCOLN'S SPARROW.**

A somewhat irregularly distributed species, even during the migrations. Nowhere very abundant, but occurs more plentifully than generally supposed. Mr. Clark calls it an irregular migrant, in small numbers, in Dunn County. Dr. Hoy did not consider it rare about Racine, and stated that a few nested. Dr. Ogden reports it rather plenty at Milwaukee. A regular migrant at Lake Koshkonong, especially in spring, and sometimes a summer resident, though no nests have been found. Appears to be rather rare at Delavan and not noted, as yet, except in spring.

Melospiza georgiana *(Lath.).* **SWAMP SPARROW.**

Like its near relative, the song sparrow, this finch arrives early and remains very late in the fall. It is an abundant breeder in all marshy places, and is often found in perfectly dry meadows and lowlands. It is one of the species that are frequently imposed upon by the cowbird.

Passerella iliaca *(Merr.).* **FOX SPARROW.**

A common migrant early in spring, and as late in autumn. Before leaving even the southern tier of counties for the north it is sometimes in full song. Does not seem as plenty as formerly. This shy inhabitant of the brush and cover is one of our most beautiful birds, and it is a great pity it is not of a more sociable nature.

Pipilo erythrophthalmus *(Linn.).* **TOWHEE.**

Summer resident; abundant. This lovely bunting breeds in great numbers in the clearings and open patches of timber. Here on the hottest of summer days its incessant "che-wink" may be heard from all sides, as the birds scratch in the grass and leaves, or dart in and out of the hazel clumps and brush-piles. In some sections much less common than formerly; in others becoming more common.

Pipilo maculatus arcticus *(Sw.)*. **ARCTIC TOWHEE.**

A rare straggler. One specimen, an adult male, has been shot (by L. K.) in Jefferson County. This specimen was sent to Prof. Sundevall, and the record cannot be found at present. There was also a specimen—formerly preserved in the old Wisconsin Natural History Society collection—which was taken near Milwaukee about 1867 or 1868. One was noted by Dr. Hoy in a collection of birds at Dubuque, Iowa, which had been taken on the Wisconsin side of the river.

Cardinalis cardinalis *(Linn.)*. **CARDINAL GROSBEAK.**

Rare. Two specimens were procured at an early day at Lake Koshkonong. Dr. P. R. Hoy is authority for the statement that a few stragglers formerly nested near Racine. Regarding the cardinal Mr. Wm. J. Bennetts, of Milwaukee, writes us: "On February 26, 1900, Mr. F. Kirchner brought me a male he had shot that morning, feeding with the English sparrows near some barns just west of the city. It was too badly damaged to make a skin, but I still retain the head. The same week two birds of this species were mounted by Mr. Bauer, a taxidermist on Chestnut street. I am informed these were taken near the ice houses on the Milwaukee River." One or two other records are supposed to have been of escaped cage birds, but it seems probable that all the above were wandering wild birds, which extended their range a trifle farther north than usual.

Zamelodia ludoviciana *(Linn.)*. **ROSE-BREASTED GROSBEAK.**

This beautiful grosbeak is a common summer resident, and having adapted itself so well to civilization has become a common bird in towns and cities. It seems to have increased in numbers greatly in some parts of the state the past few years, and its well known propensity for destroying the potato beetle, as well as its beautiful plumage and song, should be a guarantee for its protection wherever a pair appears.

Guiraca cærulea *(Linn.)*. **BLUE GROSBEAK.**

A rare straggler in Wisconsin. Thure Kumlien captured a pair near Lake Koshkonong in June, 1860. It was also taken at least once by Dr. Hoy; and there was also a Milwaukee specimen, which seems to have entirely disappeared.

Cyanospiza cyanea *(Linn.).* **INDIGO BUNTING.**

An abundant summer resident, sharing with the little yellow warbler the right to nest in any clump of bushes bordering on, or in the woods. The female is exceedingly shy and retired, but the male loves to sit for hours at the top of some tall tree standing a short distance from the brush, and there repeatedly sing his dainty notes.

Spiza americana *(Gmel.).* **DICKCISSEL.**

A common summer resident, sometimes almost abundant. The dickcissel seems to be a very erratic bird. In some parts of the state it is rather ucnertain or rare, while in other districts it is in certain years really abundant. It was formerly rare in Walworth County, for instance, but in the season of 1901 was one of the most common of roadside birds, a male sitting every few rods along favorable highways. For the past ten years, in this county, the species has been on the increase. Taking the state at large also it is much more abundant generallv than thirty to forty years ago. Two broods are very likely reared in a summer, as we have found eggs in June, and young, only recently from the nest, in September.

FAMILY TANAGRIDÆ: TANAGERS.

Piranga ludoviciana *(Wils.).* **LOUISIANA TANAGER.**

During the latter part of May, 1877, Thure Kumlien found this species nesting within a few rods of the Kumlien homestead in Jefferson County. Nest, eggs and parents were secured, and are now preserved in the Museum of the State University at Madison. The nest was not especially different from that of *P. erythromelas*, and was placed well out on a horizontal branch of a large white oak. This is without doubt the easternmost breeding record for the species, although stragglers are reported even from New England. A second male was procured the next June (1878); and in July, 1891, another, also an adult male, was shot in the same locality by L. Kumlien.

Piranga erythromelas *Vieill.* **SCARLET TANAGER.**

A common summer resident. Arrives early in May in almost perfect plumage, and nests in all suitable woods, seeming to prefer the borders of oak groves, even along the roadside. Like some others of our nesting birds, the tanagers seeem mysteriously to disappear soon after the young leave the nest, and although they remain with us until early fall they are not often seen after the beginning of the post-nuptial moult, having retired to the most secluded woods, where they remain in the thicker tree tops the greater portion of the time.

Piranga rubra *(Linn.).* **SUMMER TANAGER.**

Rare, but evidently a regular summer visitor in southern Wisconsin. It has been taken near Janesville by Mr. H. L. Skavlem; and near Albion, twice at least, by Thure Kumlien. In the Johnstown woods, between Milton and Johnstown, it appears to occur regularly every summer, we having seen it on a number of occasions, and taken specimens. Reported from Racine by Dr. Hoy, and two specimens, taken near Milwaukee, were mounted by local taxidermists, and were formerly in the old Natural History Society collection.

FAMILY HIRUNDINIDÆ: SWALLOWS.

Progne subis *(Linn.).* **PURPLE MARTIN.**

The familiar and generally beloved martin is a common summer resident, nesting exclusively nowadays about buildings, and in bird houses placed for its especial benefit. As lately as 1869 it was still nesting in hollow trees about Lake Koshkonong, and doubtless in other sections. It does not average anywhere near as common as twenty to thirty years ago. Has been driven from many nesting sites by the English sparrow, and many young die in the nest each year for some reason unknown. It arrives from the first to the middle of April, but seems reluntant to settle down to housekeeping, and as a rule it is nearly the first of June before nesting begins.

Petrochelidon lunifrons *(Say).* **CLIFF SWALLOW.**

An abundant summer resident. Nests in colonies of from three or four to upwards of twenty-five pairs, or more, on its favorite barns. Associates constantly, before and after the breeding season, with the barn and tree swallows. It was formerly a very rare bird over some parts of the state where it is now abundant. Fifty years ago it was supposed to ascend the Mississippi and breed at only a few points, whereas at the present time it is abundant the entire width of the state. It was unknown in the early forties in Jefferson County, except as a migrant. Recorded as nesting at Racine for the first time in 1852 (Hoy). In June, 1861, it was nesting in some numbers on barns in Sauk County (Thure Kumlien), and became common in Jefferson County in 1866. In 1845 it was nesting abundantly on the cliffs at Devil's Lake, and twenty years later was still breeding there in less numbers, and more about farm houses than on the cliffs. At the present day it has almost entirely deserted the cliffs, in Wisconsin, and has gradually spread out over all the settled parts of the state, until it is one of our most common swallows.

Hirundo erythrogaster *Bodd.* **BARN SWALLOW.**

This species, although a common summer resident, is not nearly as abundant as the cliff or tree swallow. Seldom nesting in extensive colonies, it prefers to scatter, ordinarily a few, or even a single pair, occupying a building. It arrives about May first, and leaves early in September.

Tachycineta bicolor *(Vieill.).* **TREE SWALLOW.**

An abundant summer resident. The earliest of the swallows to arrive in the spring, numbers of this species are often caught by severe cold snaps, and perish in their vain attempts to procure food enough to sustain life. Many may sometimes be found, along the lake shores, that have fallen exhausted into the water, on these occasions. The tree swallow prefers to nest in the vicinity of a stream or pond, gathering a mass of feathers into some hole or natural crevice in an old stump or tree on which to lay its eggs. It is easily induced to nest in bird boxes, but not being able to cope with the English sparrow, is quickly driven away. Strange as it may seem this species often becomes the foster parent of the cowbird.

Riparia riparia *(Linn.).* **BANK SWALLOW.**

A common summer resident, but appears to be restricted to certain localities as a breeding bird, and its range in the state is very imperfectly known. Many observers who have published notes must have mistaken large numbers of the next for this species. In all our experience we have found the bank swallow nesting in any numbers only along the shores of Lake Michigan, along the Mississippi River, and about some of the larger inland lakes and rivers, where it nests in colonies. It ofttimes occurs in great numbers along Lake Michigan. In the interior it occurs chiefly as a fall migrant, the common nesting "bank swallow" being the next species.

Stelgidopteryx serripennis *(Aud.)*. **ROUGH-WINGED SWALLOW.**

From our observation this is the common breeding "bank swallow" which is found scattered over the most of the state. It is usually found nesting in single pairs, or not more than two to four pairs in a single bank, whereas the foregoing nests in large colonies. In Jefferson, Rock, and Walworth counties the rough-wing is sometimes very abundant, flocking in spring and fall with the other swallows. From the fact that the early lists of Wisconsin birds included this species as very rare, if it was mentioned at all, it has evidently been confounded with the bank swallow by many recent observers, and, therefore, anything like the exact range for either species in the state cannot be ascertained at present.

FAMILY AMPELIDÆ: WAXWINGS.

Ampelis garrulus *Linn.* **BOHEMIAN WAXWING.**

A winter visitant. Formerly much more common than at the present day. If the weather is severe enough the Bohemian waxwing may reach southern Wisconsin by the middle of November, but it is usually later. If the spring is backward it is sometimes noted as late as April. It is especially numerous along Lake Michigan where it feeds largely on the berries of the mountain ash. We have never found it so abundant anywhere as in the cities along the lake shore where this tree has been planted along the streets. We have noted it in great numbers at Ahnapee, Kewaunee, and Two Rivers, and in 1875 it visited Milwaukee by the thousand. It feeds also on the berries of the wild grape, carrion flower and different species of smilax, also on apples, both wild and cultivated. It is generally stupidly tame and unsuspicious. Of much more regular occurrence from the central part of the state northward, also, than in the southern counties, where in fact, it has been rare of late years.

Ampelis cedrorum *(Vieill.)*. **CEDAR WAXWING.**

The cherry-bird, as this species is familiarly known, is another of those birds whose movements are decidedly erratic and uncertain. At a given point it may occur in any month of the year, or be entirely absent at any time. Ordinarily it is a common breeder, nesting in mid-summer.

FAMILY LANIIDÆ: SHRIKES.

Lanius borealis *Vieill.* **NORTHERN SHRIKE.**

A winter visitant, regular, and sometimes common. It usually appears in October. Dr. Hoy claimed that a few spent the summer in the middle and northern parts of the state, and the same idea was entertained by Thure Kumlien fifty years ago. The nearest approach to summer residence we can learn of is the case of a young bird in the brown plumage shot September 6, 1891, in Jefferson County. This bird might have come a considerable distance, however. We are unable to obtain any recent authentic records of its remaining in Wisconsin in summer, and very much doubt that it does. The northern shrike here feeds largely on the mice of the genus *Microtus*, but often catches the smaller birds also.

Lanius ludovicianus migrans *Palmer.* **MIGRANT SHRIKE.**

Summer resident. A very early arrival in spring, often nesting early in April, and again in July. A common bird in open regions, along roadsides and borders of fields, where it nests preferably in isolated, bushy-topped trees. Not as common north of the central part of the state as south of it, except toward the northwest, where it appears to be found more or less to the extreme north portion. We feel that the above name is only provisional, but prefer to include all our smaller shrikes under the one name, rather than to include in this list both *ludovicianus* and *excubitorides* as we should otherwise have to do.

FAMILY VIREONIDÆ: VIREOS.

Vireo olivaceus *(Linn.).* **RED-EYED VIREO.**

An abundant summer resident throughout the entire state. This vireo is one of our commonest nesting birds, although, hiding itself away in the most retired woodlands, as it usually does, it is as little known to the average person as some of our rarest visitors. Here, in any quiet spot, its beautiful song may be heard on all sides the entire summer through. No species appears to be as persistently imposed upon by the renegade cowbird as is the little red-eye; indeed, it is a rare circumstance to find a nest that does not contain one or more eggs of this miserable nuisance.

Vireo philadelphicus *(Cass.).* **PHILADELPHIA VIREO.**

A regular migrant, especially through the eastern half of the state, where it is of rather common occurrence. It is usually found in company with the migrating warblers in May and September. It is much more common during the autumnal migration than in spring.

Vireo gilvus *(Vieill.).* **WARBLING VIREO.**

In some sections of the state the warbling vireo is an abundant summer resident, and one of the most common of breeding birds, while in other less fortunate districts it seems to be confined largely to migrations, although plenty enough then, and appearing in good numbers during late summer. The species is at more at home in the vicinity of dwellings and along the roadsides than its near relatives, nesting, as a rule, in these localities and leaving the deeper woodlands to the equally abundant red-eyed.

Vireo flavifrons *Vieill.* **YELLOW-THROATED VIREO.**

The yellow-throated vireo is a common summer resident in all parts of the state, but by no means so abundant generally as either *olivaceus* or *gilvus*, though exceeding the latter in numbers in some localities. During the migrations, May and September, it is more abundant than at any other time, and is then found everywhere that there are trees, seeming to prefer the open groves to the thicker growths. The nest is one of the most beautifully made of any of our birds, and it is indeed a fine sight to watch a pair of these vireos at work on the little basket-like structure that is to contain the equally exquisite eggs.

Vireo solitarius *(Wils.).* **BLUE-HEADED VIREO.**

A common migrant in May and September, and a regular summer resident in limited numbers. Dr. Hoy reported it as nesting at Racine, and we have noted it as a summer resident at Madison, Two Rivers, Milwaukee and Jefferson. We have, however, found but one nest (Bark River Woods, Jefferson County), and this contained young almost able to fly. It appears to be more common than formerly.

Vireo noveboracensis *(Gmel.).* **WHITE-EYED VIREO.**

A rare summer resident in southern Wisconsin. So few records are obtainable at other points than Lake Koshkonong that we are able to learn but little regarding the distribution of this species in the state. It is doubtful if it occurs, even in limited numbers, much north of this locality, as several competent observers and sharp collectors have failed to find it.

FAMILY MNIOTILTIDÆ: WOOD WARBLERS.

Mniotilta varia *(Linn.).* **BLACK AND WHITE WARBLER.**

An abundant migrant, and tolerably common summer resident. This species is one of the first of the warblers to arrive, appearing in the southern part of the state with the myrtle and palm warblers during the latter part of April. It is common from then until close to the breeding season, when its numbers are greatly diminished. On the southern migration it begins to increase in numbers in August and is again abundant until October.

Protonotaria citrea *(Bodd.).* **PROTHONOTARY WARBLER.**

In suitable localities in the southern and western parts of the state the prothonotary warbler is not a rare summer resident. It was first noted at Lake Koshkonong in 1867, since which time it seems to have become more plenty. Specimens have been recorded from nearly all parts of southern and central Wisconsin. Mr. Clark has so far failed to find it in Dunn County. The northernmost record we are able to obtain is for Shiocton, Outagamie County, May 4, 1882 (1). Apparently more common along the Mississippi than elsewhere in the state. Most observers fail to visit the dense, miry, weed and willow covered overflown swamp lands where this bird makes its summer home. Considerable numbers nest yearly at Lake Koshkonong. In migrations it visits the woods with warbler flocks.

Helmitherus vermivorus *(Gmel.).* **WORM-EATING WARBLER.**

One of the southern species that rarely straggle to Wisconsin. Thure Kumlien procured one specimen at Lake Koshkonong in May, 1873, and one in May, 1877. We have seen a specimen mounted at a taxidermist's shop in Milwaukee which was said to have been taken at that city, and there was no reason to doubt the statement. Dr. Hoy says: "A few nest in this section. Rare." (Racine.) As we remember it he procured but three specimens in all, and knowing it

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1. Grundtvig, Trans. Wis. Acad. Sci., Arts and Let., X, p. 140.

to be a southern species supposed, of course, that it bred, if it occurred there at all.

Helminthophila pinus *(Linn.)*. **BLUE-WINGED WARBLER.**

Rare summer resident in southern Wisconsin. One adult female taken by Thure Kumlien June 14, 1867, in the Bark River woods, Jefferson County. One obtained by Mr. C. H. Stoddard, May 7, 1885, at La Crosse (1). Save for these two records the bird was unknown in Wisconsin until July 11, 1897, when we found an entire family, parents and four or five young, and took one of the latter, near Delavan. These had been undoubtedly reared here, but a careful search the next year (1898) produced but a single male, taken May 22. On May 14, 1899, one was seen nest building in the same wood. Three days later the nest, although still unfinished, contained one egg, and a bird was again seen with nesting material in its beak. On the 22nd. the nest was again visited, and the parent shot as she flew from the nest, which now contained six eggs. But one blue-wing had as yet been seen at a time, although the continual "chip, chip" of the mate, the exact call of the one killed (which subsequently proved to be the female) had been frequently heard from the surrounding thicket, while this one was in sight. After a half hour's patient waiting he appeared, and at once showed his deep anxiety and uneasiness at finding us so near the nest. This bird was also shot and proved to be a male Nashville warbler (*H. rubricapilla*) with enormously developed testes. There is not a shadow of a doubt that this bird was the male parent of the clutch of eggs; no one could question that for a moment who had seen his actions at the nest, and although we watched the spot constantly the entire afternoon until nearly dark, remaining hid in the brush, no other bird, Nashville or blue-wing, put in an appearance, nor did we hear a note or call that could have come from either species. Furthermore although collecting in these woods the entire summer not another Nashville warbler was seen short of five miles from the place, and the immediate vicinity of the nest was continually and carefully searched for either species without success. Possibly in our haste to positively identify this rare Wisconsin take, more interesting hybrids between the blue-wing and allied species were destroyed in embryo, as had we known the true state of affairs, the eggs would have been allowed to hatch unmolested

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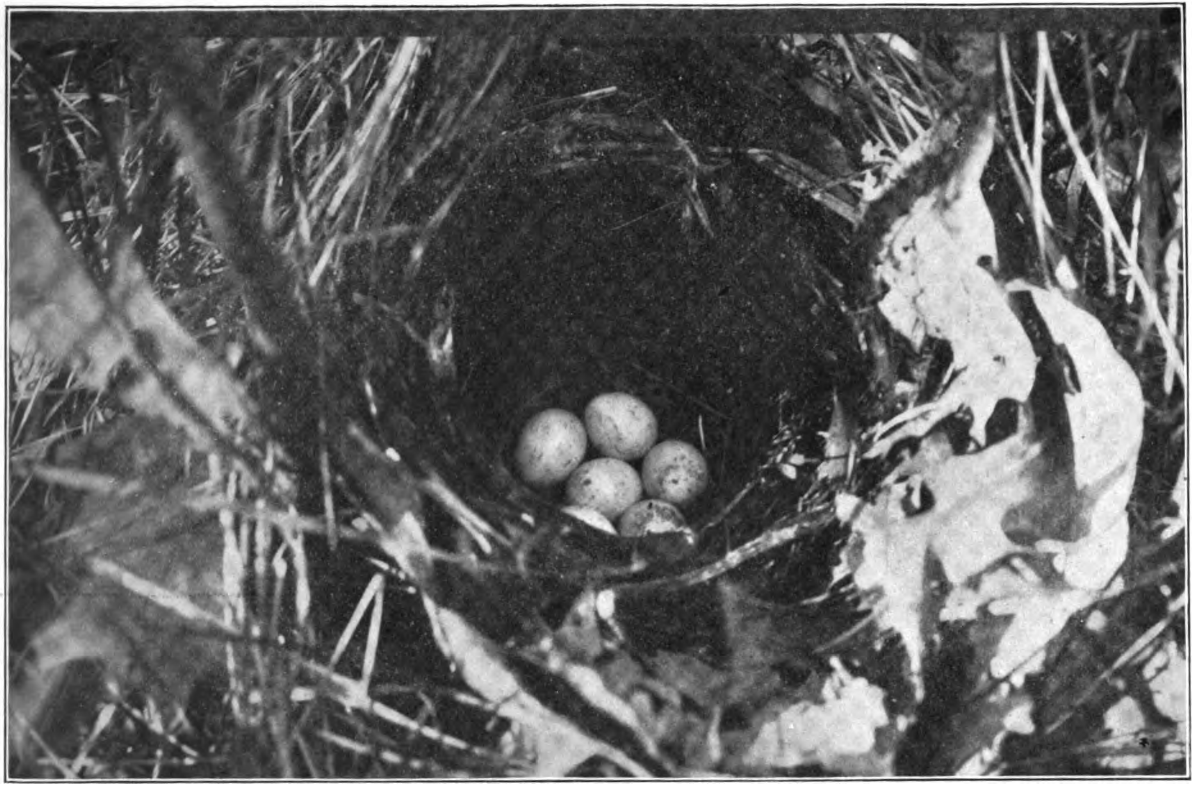
1. Report Bird Mig. in Miss. Valley, by W. W. Cooke, Washington, 1888, p. 240.



NEST AND EGGS OF BLUE-WINGED X NASHVILLE WARBLER.

Photo. by F. E. BURROWS.

in the hope of further developments. Since this time two more specimens have been taken in Walworth County, both in the month of May, and the last, a female, within twenty rods of where the young were found in 1897. Neither of these was apparently breeding when killed.

Helminthophila chrysoptera *(Linn.)*. **GOLDEN-WINGED WARBLER.**

This superb warbler is a regular, though rather rare, migrant, and a summer resident from the southern part of the state northward. Dr. Hoy took several nests at Racine, and T. Kumlien procured fledglings in Jefferson County. Grundtvig found it common, in fact, "extremely numerous," in Outagamie County in 1882-3. He found it a common summer resident, but did not find a nest. Recorded by Willard as breeding in Brown County, and by Mr. J. N. Clark from Dunn County. We have found it more common along Lake Michigan than elsewhere, and a rather common breeder at Two Rivers in 1881. It is a regular summer resident in Jefferson County, but as elsewhere is restricted to favorite localities.

Helminthophila rubricapilla *(Wils.)*. **NASHVILLE WARBLER.**

A common migrant, becoming exceptionally so in occasional years, especially in the spring. The Nashville warbler nests regularly in different parts of the state. We have nesting records at different times in Walworth County, at Lake Koshkonong, Dunn County, and northward. It is an especially common migrant along Rock River Valley. A favorite nesting site seems to be in tamarack swamps, the nest being placed on *sphagnum*, or reindeer moss.

Helminthophila celata *(Say)*. **ORANGE-CROWNED WARBLER.**

Not a very common species in Wisconsin. From the records and observations we are able to bring together it seems considerably more common in the western than in the eastern part of the state. Mr. J. N. Clark finds it common in Dunn County. In Jefferson and Dane counties it cannot be called common, though regular, especially in spring. It arrives rather earlier than others of the same genus, often in the latter part of April. Dr. Hoy was positive that it bred in the state, and we have taken specimens in Manitowoc County in July. These had without question bred there. Thure Kumlien also procured two specimens in Jefferson County on June 16 (1860).

We are confident that it bred in Bayfield County twenty years ago. The majority pass beyond our borders, however.

Helminthophila peregrina *(Wils.).* **TENNESSEE WARBLER.**

Usually an extraordinarily abundant migrant, especially in fall, at some seasons far out-numbering any other species. From all records we can bring together the verdict seems the same—very abundant migrant, but no authentic record of being summer resident, although it is at times common, even in the southern counties, by August 15.

Compsothlypis americana ramalinæ *Ridgw.* **WESTERN PARULA WARBLER.**

A common migrant in all parts of the state, and a summer resident in all suitable localities. Mr. Clark has observed it a number of times during the entire summer in Dunn County. Dr. Hoy found it a regular breeder about Racine, and took several nests. Grundtvig states that many breed in Outagamie County, where he found nests and eggs. Willard gives it as breeding in Brown County. The bird is much more common than generally supposed by the amateur observer. It is easily overlooked during the breeding season, as in this section it usually nests at a great height.

Dendroica tigrina *(Gmel.).* **CAPE MAY WARBLER.**

Migrant in May and from the last of August until the middle of September. In some years it is greatly abundant, and in others quite the reverse. Dr. Hoy found it rather common at Racine in May, and thought that a few bred there in 1852. Mr. Grundtvig found it abundant in Outagamie County in 1882, but did not find half as many the following year. Records from all sections of the state seem to indicate that it is more or less common, especially as a spring migrant. So far as our observation goes it is more common along Lake Michigan than elsewhere. We have no very good records of summer residence, although we saw a number of adult males in June between Green Bay and Sturgeon Bay, in Kewaunee and Door counties. It has also been reported from near Ashland in July.

Dendroica æstiva *(Gmel.).* **YELLOW WARBLER.**

The "yellow-bird" is an abundant summer resident, nesting in every piece of open wood and brushy clearing. It is among the first arrivals of the warblers during the last few days of

April, and is busily engaged at nest building by the 10th of May. Universally common and generally distributed over the state.

Dendroica cærulescens *(Gmel.)*. **BLACK-THROATED BLUE WARBLER.**

A common migrant from May 10 to May 30, and from the first of September until October. All points from which we have any record give this species as common. We are disposed to consider it as really a summer resident in the northern part of the state. There are several records of summer specimens from different sections.

Dendroica coronata *(Linn.)*. **MYRTLE WARBLER.**

Migrant. The most abundant of all the warblers, the first arrival in the spring, and the last to leave us in the autumn. During late September and October it flocks along the roadside like the junco and tree sparrow. Sometimes taken in southern Wisconsin as late as December 1. King (1) says "a few may breed in northern Wisconsin, for I obtained a male at Elk Lake in Chippewa County, July 26, 1876." We have never found it in the state in summer.

Dendroica maculosa *(Gmel.)*. **MAGNOLIA WARBLER.**

The beautiful magnolia is also one of our most abundant warblers during the migrations, which reach their height through May and September. There are no authentic records of this species nesting within the state, but as it is recorded as nesting at Mackinac Island and in the north peninsula of Michigan it would not be surprising if a few summered in the state. All observers report it as common during the migrations, but it is far less plenty than thirty years ago.

Dendroica rara *(Wils.)*. **CERULEAN WARBLER.**

A rather rare species in Wisconsin, though of regular occurrence, especially along Lake Michigan. There are many records for Lake Koshkonong, as this section has been closely observed for a long period. There are also records for Delavan, Milwaukee, Racine, Two Rivers, etc. Mr. Clark has not found it in Dunn County. Dr. Hoy considered it as a breeding species, which is very probably true. There is one record for Lake Koshkonong, June 14 (1872).

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1. Econ. Rel. Wis. Birds, Geol. of Wis. I, 503.

Dendroica pensylvanica *(Linn.)*. **CHESTNUT-SIDED WARBLER.**

An abundant migrant and common summer resident. In the migrations this warbler is found everywhere, but during the summer it prefers the open clearings that have grown up thickly with brush of all kinds, particularly hazel and oak scrubs. It frequently becomes the foster parent of the cowbird. This elegant species seems fully as plenty as thirty-five years ago.

Dendroica castanea *(Wils.)*. **BAY-BREASTED WARBLER.**

A common migrant, especially in the fall. At this season it sometimes outnumbers all other species. In Jefferson County young have been taken by the middle of August, and we have suspected that some, at least, nest in the extreme northern part of the state, as is surely the case in the northern peninsula of Michigan. An authentic Wisconsin nesting record is, however, yet to be obtained. Some observers report this species as rare, and even absent from certain sections, which it seems must be entirely the fault of the observer. The young in the fall are often confounded with the next. The height of the spring migration in southern Wisconsin ranges from May 10 to May 20, according to the season, and in autumn is from the last days of August to the middle of September. Apparently more common along Lake Michigan than in the interior. Belated individuals have been shot in Jefferson County as late as June 10.

Dendroica striata *(Forst.)*. **BLACK-POLL WARBLER.**

Usually the last of the genus to arrive in spring, it is sometimes well toward the end of May when the black-poll becomes abundant. Returning it is common again during the latter half of September and well into October. So far as our records show, it is a common migrant in all parts of the state. There is no authentic nesting record of the species, but it has been noted in the northern counties in June and July, and no doubt a few breed within our borders.

Dendroica blackburniæ *(Gmel.)*. **BLACKBURNIAN WARBLER.**

An abundant migrant, arriving with the warbler host early in May. A few nest regularly in the state, even in the southern counties, most often in the tamarack swamps. Eggs have been taken in Jefferson County and young in Manitowoc County (L. K.). Mr. J. N. Clark, of Meridian, writes of this species, and the warblers in general: "Our warblers of every variety, it appears to me, are diminishing in numbers every year. Ten years ago from the 10th to the 25th of May the woods seemed to be alive with them, and I have counted more than a dozen varieties in two hours' observation. Now half a day's search will not reveal half that number. This is also true of many of our insectivorous birds, the Baltimore oriole, phœbe, the vireos and most of the finches being exceptions." This is probably too true of some localities, and probably generally throughout the state to some extent, but there are still many localities where a dozen varieties of warblers can easily be identified, in good numbers, in even less than two hours.

Dendroica dominica albilora *Ridgw.* **SYCAMORE WARBLER.**

A rare straggler to Wisconsin. Dr. Hoy obtained a single specimen at Racine, June 20, 1848. Taken but once by Thure Kumlien, in 1877, at Lake Koshkonong, and once at some other locality in southern Wisconsin at a very early date, 1842-50.

Dendroica virens *(Gmel.).* **BLACK-THROATED GREEN WARBLER.**

Migrant. As is the case with many of the warblers, this one occurs in varying numbers, being sometimes only fairly common, and again greatly abundant, either in spring or fall. Dr. Hoy wrote that a few nest with us, and Mr. Clark suspects that they breed in Dunn County, as he has found them during the summer months. Young just able to fly were taken in Jefferson County in July, 1868, and adults are frequently seen in summer as far south as Rock, Dane, and Jefferson Counties. We have known several pairs to remain in the vicinity of Milton all summer but have never succeeded in finding a nest.

Dendroica vigorsii *(Aud.).* **PINE WARBLER.**

A fairly common summer resident in the pine regions. Migratory in the hardwood districts of southern Wisconsin. Much more common along Lake Michigan than in the interior. A rather early arrival in the spring, generally preceding the majority of the warblers by several days. Although we have never found the nest we have noted this bird at various northern points in June and July. Dr. Hoy gives it as breeding in the northern pine forests, and Mr. Nelson found it nesting in northeastern Illinois.

Dendroica palmarum *(Gmel.).* **PALM WARBLER.**

One of the most numerous and regular of the warblers during the migrations, from the latter part of April until the middle of May, and again from the last half of September until the middle of October. We can find no evidence that it is ever a summer resident within the state, even in the most northern counties. It is one of the earliest arrivals, and frequents the open country along roadsides, rather than the localities usually selected by warblers.

Dendroica discolor *(Vieill.).* **PRAIRIE WARBLER.**

A rare straggler to Wisconsin. Dr. Hoy procured but one specimen at Racine, and Thure Kumlien but one at Lake Koshkonong. Unfortunately the dates of capture of both specimens are gone, but both were taken at a very early day, between 1845 and 1860. This species has been recorded from Wisconsin in migration reports by amateurs. One specimen sent us to verify such a record proved to be *D. palmarum.* The Hoy and T. Kumlien specimens are probably the only actual records for the state.

Seiurus aurocapillus *(Linn.).* **OVEN-BIRD.**

A common bird throughout the summer, the oven-bird nests in suitable localities over the entire state. It arrives with the majority of the warblers the last of April, or very early in May and by June 1 has its oddly roofed nest completed and the eggs laid. During the breeding season the birds are shy and retiring, and the nest is not easily found, the birds retreating as one walks upon them, and by a long circle returning, unseen, to their home. Few sets can be found without one or more cowbirds' eggs. One set in the Kumlien collection contains three eggs of the oven-bird, and five of the cowbird.

Seiurus noveboracensis *(Gmel.).* **WATER-THRUSH.**

This form of the water-thrush is a common migrant and regular summer resident. It breeds sparingly in the southern counties, and more commonly and regularly farther north. Grundtvig found it a common nesting bird in Outagamie County, and Mr. J. N. Clark writes that it sometimes nests in Dunn County. We are almost exactly on the "dividing line" between *noveboracensis* and *notabilis*, but the former is by far the more abundant. They occur together in southeastern Wisconsin during the migrations. Mr. Wm. Brewster has kindly examined our specimens and finds perfectly typical examples of both races.

Seiurus noveboracensis notabilis *(Ridgw.)*. **GRINNELL'S WATER-THRUSH.**

Regular migrant, even in the extreme southeastern part of the state. Specimens of this race were identified by Mr. Wm. Brewster among the water-thrushes sent for his inspection. It occurs at the same time, and in company with the preceding, and may possibly be the nesting form in the western part of the state. Unfortunately, we have no breeding birds from this district.

Seiurus motacilla *(Vieill.)*. **LOUISIANA WATER-THRUSH.**

The Louisiana water-thrush occasionally occurs in the spring in southern Wisconsin, and doubtless breeds, as this is the extreme northern part of its range. One specimen has been taken at Delavan, Walworth County (May 18, 1900. N. H.), and one in Milwaukee County (April 25, 1897—Copeland and Russel), besides four or five in all about Lake Koshkonong, during the past fifty years.

Oporornis formosa *(Wils.)*. **KENTUCKY WARBLER.**

We appear to be a little too far north for this exquisite species. In southern Wisconsin it is very rarely taken during the spring migrations, when an occasional individual seems to wander out of its usual range. Dr. Hoy took one specimen at Racine (May 10, 1851), and we have but six other records for the state for sixty years, all about Lake Koshkonong, in spring.

Oporornis agilis *(Wils.)*. **CONNECTICUT WARBLER.**

Not so rare a species as generally supposed. By one familiar with its haunts, song and habits, it can be found in some numbers during the latter part of May, the first week of June, and again during September. It is generally spoken of as more common in spring than fall, but we are unable to see any material difference, and if anything find more in autumn, as the young are less shy than the spring adults, and are consequently more often seen. Dr. Hoy considered it not uncommon at Racine, and shot a mated pair, about to begin nest building. In Jefferson County a pair was found, June 16, 1874 (L. K.), putting the finishing touches upon their nest. It was placed on the ground in a dense thicket of hazel, briars, etc. Though the nest was not touched they abandoned it, but bred in the same thicket; the nest, however, could never be found. Has been found in the dense tamarack swamps of Jefferson County in July, on several occasions, when it was, without question, nesting, and we have no doubt that a considerable number nest within the state. It is the very last warbler to pass northward in the spring. Many observers fail to find this species. Mr. Clark has not, as yet, taken it in Dunn County, and it was not found in the State by King, Grundtvig, or Willard.

Oporornis philadelphia *(Wils.)*. **MOURNING WARBLER.**

Migrant. Of very similar habits to the preceding, frequents much the same localities, and, according to our observations, in about the same numbers. It arrives somewhat earlier in spring than *agilis*. In some years it is almost common during the spring migration, for a few days, at Delavan and Lake Koshkonong. Reported by J. N. Clark from Dunn County, but not noted by King or Grundtvig. Dr. Hoy (Racine), and E. W. Nelson (northeastern Illinois), called it rare. By no means rare along Lake Michigan in migrations, especially in spring. Notwithstanding the general breeding range of the two species, as usually given in works of authority, we are of the opinion that this species never breeds in Wisconsin, although the *other does*, quite the opposite of the case, as usually given. We think any breeding record of this species for Wisconsin that may ever have been published, must surely refer to *agilis*. We cannot resist following Mr. Ridgway in including this species in the genus *Oporornis*, where it certainly appears to belong.

Geothlypis trichas brachidactyla *(Swains.)*. **NORTHERN YELLOW-THROAT.**

An abundant summer resident in all suitable localities, and especially numerous during the fall migrations, from the latter part of August until the middle of September. Mr. Wm. Brewster has examined our yellow-throats and writes us under date of July 31, 1902, as follows: "Despite the fact that Palmer calls the bird of the entire upper Mississippi Valley region, east of the 97th meridian, *trichas*, your specimens agree closely with his description of *brachidactyla*, and with my New

England specimens of the same." Prof. Ridgway's views (1) seem to be the same as Mr. Brewster's, and our Wisconsin yellow-throat will, without doubt, stand as *brachidactyla*.

Icteria virens *(Linn.).* **YELLOW-BREASTED CHAT.**

In the southern part of the state the chat is a regular summer resident, and in favorable localities breeds rather commonly. It is almost invariably found in some large opening in the wood which has thickly grown up to hazel brush and dogwood, and it is in the latter that the nest is usually placed. The birds are, as a rule, exceptionally shy and retired, and would pass unnoticed by the average observer were it not for the occasional outbursts of their variable mimicry and song. Then by careful stalking one may perhaps be fortunate enough to obtain a glimpse of a streak of yellow and green darting into the air, only to tumble over again into some thicket. When one has located the nest, however, all is different, and one has abundant opportunity to see and hear the birds, as they scold and fret, forgetting their wildness for the time, and coming within a few feet of the intruder. The least disturbance, even to barely touching the nest, is often enough to cause the birds to throw out the eggs, and desert the place, so shy and suspicious are they. The hottest and brightest June or July day is the best to find chats, as it is then that they are at their best in ventriloquist calls and song. Nesting begins early in June, and incubation is finished by the middle of the month. The nests are favorites with the cowbird and nearly always contain one or more of its eggs. The most northern record we have for this species in the state is at Stevens Point.

Wilsonia mitrata *(Gmel.).* **HOODED WARBLER.**

Not an uncommon migrant along Lake Michigan in southern Wisconsin, and it undoubtedly breeds to the northward of Milwaukee. Much less common in the interior than along the lake shore. We have seen this species repeatedly at Two Rivers in July, but in Jefferson, Dane, and Rock counties only in the spring migration in May. We have also taken specimens at Milwaukee in the latter part of May.

Wilsonia pusilla *(Wils.).* **WILSON'S WARBLER.**

A common migrant in southern Wisconsin, passing northward late, often as late as the first week of June. Undoubtedly

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1. Birds N. and Mid. Am., Bull. U. S. Nat. Mus., No. 50, pt. II, pp. 655-665.

a few nest in Wisconsin, even as far south as Jefferson County, although there is no actual record. Specimens have been taken near Jefferson, June 16. Young birds are often taken as early as the middle of August in the large tamarack swamps. Principally a frequenter of low lands, and willowy thickets, often in tamarack swamps.

Wilsonia canadensis *(Linn.).* **CANADIAN WARBLER.**

A common migrant during the latter part of May, and again in September. A few nest in central and northern Wisconsin, along the borders of hemlock swamps, but the great majority pass beyond our borders to summer. King mentions taking a fully fledged young bird near Worcester, July 19, 1876 (1), and a pair were seen feeding young, which were flying about, on July 12, 1882, in Door County, to the northward of Sturgeon Bay (L. K.). Nelson reports it as a rare summer resident in northern Illinois. Grundtvig found it the most abundant warbler in Outagamie County in 1882 and 1883, except *Dendroica maculosa*. All other observers report it as common, except King, who calls it rare in central Wisconsin, where it has been noted by others as abundant for the past forty years. More plenty along the borders of swamps abounding in a thick growth of coniferous trees than in the hardwood.

Setophaga ruticilla *(Linn.).* **AMERICAN REDSTART.**

A summer resident. The redstart breeds abundantly in all deep, second-growth woods, though, as usual with many warblers, it prefers the vicinity of a lake, pond, or stream for its summer home. Nesting begins in May, and the family remain together the entire summer, a happy, beautiful, woodland-roving flock of parents and young.

FAMILY MOTACILLIDÆ: WAGTAILS.

Anthus pensilvanicus *(Lath.).* **AMERICAN PIPIT.**

A common migrant, but not always to be depended upon in any locality. On the prairies, dry marshes, and along the lake shore it is sometimes abundant, especially in September and October, and even to November 1. Specimens were taken from a flock near Lake Koshkonong, June 3, 1879, but as might be expected, showed no indications of breeding soon.

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1. Geol. of Wis., I-p. 509.

FAMILY TROGLODYTIDÆ: WRENS, THRASHERS, ETC.

Mimus polyglottos *(Linn.).* **MOCKINGBIRD.**

A rare summer visitant. Many of the records of the mockingbird in Wisconsin are very doubtful, as they are mostly of birds "seen" only, and with a bird of this kind such records are always open to question, as observers not familiar with the species are very likely to make serious mistakes in their anxiety to add a new species to their local list. There is also the regular possibility of its being an escaped cage bird. We have positive records of its nesting on the old Kumlien homestead, in Jefferson County, however, in June, 1879 and 1880, and of one specimen captured in Milwaukee County in August, 1882 (L. K.). Hoy reported specimens seen July 16, 1851, between Racine and Kenosha, and July 26, 1846, near the southern state line. Later (1885), Hoy wrote that mockingbirds nested freely near Racine previous to 1856, that he obtained three nests and knew of several others that he did not molest, but that none had been seen for fifteen or twenty years. In the Bulletin of the Wisconsin Natural History Society for January, 1900, Mr. W. J. Bennetts records one seen by himself June 29, 1894, near Milwaukee, in the same locality where Mr. John W. Dunlop had reported a pair nesting a few years ago, and also states that Mr. Robert O. Wanvig has a nest and eggs, taken in 1897, just west of Milwaukee, from a sheltered grove where he has seen the birds for the past few summers.

Galeoscoptes carolinensis *(Linn.).* **CATBIRD.**

A common summer resident over the greater part of the state. Arrives from the south about the first of May, and very soon commences nest building. A common species about dwellings and towns, unlike the thrasher, adapting itself to civilization and the vast changes which follow in its wake.

Toxostoma rufum *(Linn.).* **BROWN THRASHER.**

Formerly an abundant summer resident. The brown thrasher seems to have greatly diminished in numbers during the past fifteen years, until now it is scarcely common in many localities, and really rare in some, where it once bred in good numbers. That such a magnificent bird, with so fine a voice should grow less in numbers at such a rate is a great pity, and the species should be carefully guarded and protected in every way possible here in its summer home. In some parts of the state it is still fairly common.

Thryothorus ludovicianus *(Lath.).* **CAROLINA WREN.**

A rare straggler to Wisconsin. We have never met the species in the state, and its presence must be considered as merely accidental. One specimen was preserved by Thure Kumlien, which was taken in the summer of 1878 near Janesville. It is recorded by Dr. Hoy, a single bird, from Racine, July 5, 1852. One other specimen at least was taken by Hoy of which we have personal recollection, but the record cannot be found. A single specimen secured at Milwaukee in the summer of 1881, was seen at the shop of a taxidermist in that city.

Troglodytes aëdon *Vieill.* **HOUSE WREN.**

A common migrant in eastern Wisconsin in almost equal numbers with the next. It breeds sparingly anywhere from the southern border northward. It arrives the last week of April and is common until the middle of May, when all but a few pass northward. It nests late in June, in towns and villages as well as in the more retired woods. Mr. Brewster has examined our series of house wrens, and pronounces nearly half to be typical *aëdon.*

Troglodytes aëdon aztecus *Baird.* **WESTERN HOUSE WREN.**

In a series of house wrens from southern and eastern Wisconsin, Mr. Wm. Brewster finds typical examples of both forms, *aëdon* and *aztecus*, the latter slightly predominating in numbers. These specimens were nearly all taken during the spring migrations of various years, and give no clew to the distribution of the two forms during the breeding season. The *aztecus* averaged a little later, but both were sometimes taken on the same day. As the house wrens do not nest until June, as a rule, and this series was mostly made in late April and May, no actual breeding birds at present being available, we are unable to state whether this form nests within the state or not. Mr. Clark finds it a common migrant in Dunn County, and notes that it may occasionally nest, as he has seen it in mid-summer. Possibly these birds, nesting in that portion of the state, are *aztecus*, but actual breeding birds must be had before the summer range of the two forms in the state can be definitely known.

Olbiorchilus hiemalis *(Vieill.).* **WINTER WREN.**

The little winter wren is a common migrant throughout the state, in early spring and late fall. It unquestionably nests in northern Wisconsin. King (1) found it common in summer in the northern parts of the state, and Dr. Hoy states that it nests on the shores of Lake Superior. Grundtvig thinks that a pair nested in Outagamie County in 1883 (2). Parents were seen feeding young just able to fly, near L'Anse, in the upper peninsula of Michigan, in July, 1879 (L. K.).

Cistothorus stellaris *(Licht.).* **SHORT-BILLED MARSH WREN.**

A common summer resident in many parts of the state, especially in localities where there are still wild meadows and dry marshes. In other parts, where there are not suitable nesting grounds for the species, it appears to be rare. In Dunn County, Mr. Clark states, it is not nearly as common as formerly, but still nests in most favorite meadows. On Turtle Creek marsh, between Delavan and Whitewater, it is almost abundant, and in late afternoon, if one remains quiet and well hidden, several pairs may be heard singing near by. At the first move, however, they drop into the grass with an angry scold, but soon appear again, often on the opposite side, chattering as only wrens can. Although so plenty on this particular marsh the entire summer, it is seldom seen in any of the surrounding country.

Cistothorus palustris *(Wils.).* **LONG-BILLED MARSH WREN.**

An abundant summer resident over nearly the entire state, breeding in great numbers about all suitable marshes. The long-bill prefers much wetter localities than the last, and the two species are seldom found in close proximity to one another.

FAMILY CERTHIIDÆ: CREEPERS.

Certhia familiaris americana *(Bonap.).* **BROWN CREEPER.**

In the southern counties the creeper is a migrant and winter resident only, and most common during April, but in the northern part of the state it is found throughout the summer, and breeds. From the records at our command it is evident

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1. Geol. of Wis., 1873-79, I, p. 491.
2. Trans. Wis. Acad. of Sci. Arts and Letters X. p. 153.

that it summers regularly, though sparingly, from the central part of the state northward. Grundtvig was quite certain that a few bred in Outagamie County, and J. N. Clark observed a pair of creepers feeding a young cowbird, just from the nest, at Meridian in late June, 1897.

FAMILY PARIDÆ: NUTHATCHES AND TITS.

Sitta carolinensis *Lath.* **WHITE-BREASTED NUTHATCH.**

Common. Resident in some numbers the entire year. Nests throughout the state, and becomes more common during fall, winter, and spring, at which time it is a regular city visitor, frequenting the larger trees along the streets.

Sitta canadensis *Linn.* **RED-BREASTED NUTHATCH.**

A regular spring and fall migrant, but not so common as the white-breast. Mr. Clark has found it in winter in Dunn County, and it occurs as late sometimes as November in Walworth, Jefferson and Rock Counties, though usually found in April and September. It was found nesting at Pine Lake, near Hartland, July, 1888. The nest was about ten feet above the ground in a pine stub, and contained young (L. K.). Dr. Hoy states that a few nested near Racine, and as Nelson mentions it as a rare summer resident in northeastern Illinois, it may yet be found nesting in other parts of our state.

Parus bicolor *Linn.* **TUFTED TITMOUSE.**

A straggler from the south. In the museum of the University of Wisconsin there is a single specimen of the tufted tit, shot by Mr. N. C. Gilbert, December 15, 1900, near Madison. The bird was alone, and this is doubtless the only record for the state.

Parus atricapillus *Linn.* **CHICKADEE.**

Abundant. Found in all parts of the state, and resident wherever found. Nests early in May. In winter the chickadee becomes very tame and is often seen about the yards of city residences.

Parus atricapillus septentrionalis *(Harris).* **LONG-TAILED CHICKADEE.**

In late fall and winter typical specimens of this form are taken in Wisconsin, even in the southern part of the state, but more often in the northwestern portion. A number were taken near Hudson in November. We are unable to say whether these are resident in that district, or merely winter visitors.

Parus hudsonicus *Forst.* **HUDSONIAN CHICKADEE.**

A rare winter visitant in southern Wisconsin. Dr. Hoy states that a few visited Racine during the unusually cold January of 1852. A single specimen was taken by Thure Kumlien in Jefferson County at this same time. It is recorded from the northern peninsula of Michigan (Nehrling) and Dr. H. V. Ogden, of Milwaukee, writes us that he saw several, and shot one, in Iron County, but unfortunately did not preserve a skin. He also writes: "I fancy a few could be found every fall in the northern tier of counties." A single individual was noted in Vilas County, at close range, while waiting on a deer runway, in November, 1902, but could not be collected as we were armed only with rifles at the time (N. H.).

FAMILY SYLVIIDÆ: KINGLETS AND GNATCATCHERS.

Regulus satrapa *Licht.* **GOLDEN-CROWNED KINGLET.**

An abundant migrant in early spring and late fall. Dr. Ogden states that it is sometimes found in mid-winter in Milwaukee County, and the same is true of other sections of the state. The golden-crown breeds along the south shore of Lake Superior, in Ontonagon County, Michigan, and possibly to some extent therefore in the pine regions of northern Wisconsin.

Regulus calendula *(Linn.).* **RUBY-CROWNED KINGLET.**

An abundant migrant, somewhat later than the preceding, and more uniformly distributed. It seldom, if ever, remains through the winter.

Polioptila cærulea *(Linn.).* **BLUE-GRAY GNATCATCHER.**

The little gnatcatcher is a fairly common summer resident in the southern part of the state. It arrives early in the spring, in small flocks of half a dozen or more, sometimes by the last week of April. Dr. Ogden has found it breeding in Milwaukee County, and at both Delavan and Milton it nests in reasonable numbers every year. Nest building usually begins by May 20, and by June 1 incubation has commenced. The young are still in the nest up to June 15 or 20, and the families remain together the entire summer. Mr. Clark has never taken this species in Dunn County during a great many years of active collecting and observation. It is doubtful if it is common north of the southern tier of counties, except along Lake Michigan, where it is found in fair numbers as far north as Two Rivers.

FAMILY TURDIDÆ: THRUSHES, BLUEBIRDS, ETC.

Hylocichla mustelina *(Gmel.)*. **WOOD THRUSH.**

In south and central Wisconsin the wood thrush is a common summer resident. Arriving from the south the last few days of April, or very early in May, it at once sets about nest building, and incubation is usually completed, or nearly so, by June 1. The firm, solid nest is too often insecurely placed in its position in some bush or frail sapling, and frequently meets with disaster from even a light storm, delaying the birds with their family until later in the season. The majority leave by the first half of September and all have gone before October 1. One of the finest of forest songsters, its beautiful notes are best and most often heard, in all their richness, at break of day in some thick wood bordering on water, as it is in such places that the birds usually make their summer home. In Outagamie County and at De Pere, Grundtvig and Willard noted this species only as a rare straggler.

Hylocichla fuscescens *(Steph.)*. **WILSON'S THRUSH.**

A common migrant and a regular summer resident in the northern half of the state. Breeds sparingly farther south, even to the southern counties. Most abundant in southern Wisconsin during the spring migration from May 7 to May 25.

Hylocichla fuscescens salicicola *Ridgw.* **WILLOW THRUSH.**

A single specimen taken at Delavan, May 6, 1899, and identified by Mr. Wm. Brewster, is the sole claim for introducing this race here. We are of the opinion that a careful examination of the migrating *fuscescens* will reveal numbers of this form, especially, it would seem, in the western part of the state.

Hylocichla aliciæ *(Baird.).* **GRAY-CHEEKED THRUSH.**

A common migrant. Most abundant in deep woods with underbrush, or second-growth, keeping mostly, however, near the edges and openings, but ever ready to retreat to the depths of the thicket at the first alarm. Arrives early in May, the majority passing north at once, some stragglers only remaining until the last of the month, and all returning early in September on the way to their winter home.

Hylocichla ustulata swainsoni *(Cab.).* **OLIVE-BACKED THRUSH.**

An abundant migrant, and possible summer resident in suitable localities in the northern part of the State. Arrives in southern Wisconsin early in May, usually a few days later than *aliciæ,* with which it is much associated, not confining itself so closely to the woods, however, being a common bird in towns and even along the roadsides, or wherever there is cover. In the fall it is especially common through the middle of September, in scattered, woodland-roving flocks. This is one of the birds that one most frequently finds dead beneath the ever increasing network of electric wires that annually cause the death of thousands of individuals of the low-flying, night migrating species.

Hylocichla ustulata almæ *Oberh.* **ALMA'S THRUSH.**

Among specimens of thrushes sent Mr. Wm. Brewster for examination (March, 1902), were two of this sub-species. Both were shot at Lake Koshkonong late in May. The difference was detected at once on comparing with others of *swainsoni,* and it must be very uncommon in Wisconsin, although Mr. Brewster later pronounces a specimen from Delavan as "almost if not quite gray enough for *almæ*."

Hylocichla guttata pallasii *(Cab.).* **HERMIT THRUSH.**

An abundant migrant. This thrush is the first of the genus to arrive in the spring, and is usually found in southern Wisconsin by the middle of April. Migration records for many years give it the following range of dates in Walworth County: April 11 to May 17, and October 2 to 27. Specimens have been secured in Jefferson County in July, and a nest and eggs secured May 29, 1866, were *supposed* to belong to this species, but the identification is open to question. It is found in northern Wisconsin in summer, and no doubt breeds there.

King records the capture of specimens at Waupaca, July 22, 1876 (1).

Merula migratoria *(Linn.).* **AMERICAN ROBIN.**

An abundant summer resident, arriving early in March, or even the last of February, and remaining until the middle of November. Nests may sometimes be seen with the full complement of eggs as early as May 1, before a leaf has appeared on the tree in which they are placed, and young from the nest are not infrequent as early as May 25. The robin is, rarely, found in the dead of winter in southern Wisconsin.

Sialia sialis *(Linn.).* **BLUEBIRD.**

The bluebird was formerly a very abundant summer resident, but the birds which annually visited Wisconsin seem to have suffered as severely from the general southern freeze of a few years ago as those of other parts of their range. During the summers of 1895 and 1896 they were almost wholly absent, but in 1897 they appeared to be slowly gaining in numbers, and have continued steadily to increase, until now they can be classed as common summer residents again. Doubtless the day is not far distant when they will have regained their former numbers. One of the first of the real migrants to appear in spring, the date of the first arrival, of course, depending entirely on the season. They often are here by the first week in March, but it is sometimes well along in the month before the first one puts in an appearance. They remain in the fall until about November 1. Probably no bird in Wisconsin has been so persecuted in its nesting places by the English sparrow as has this species. Formerly a common resident of the towns and villages, nesting anywhere within a few feet of, or even about the buildings, it has been almost entirely driven to the country by this miserable pest.

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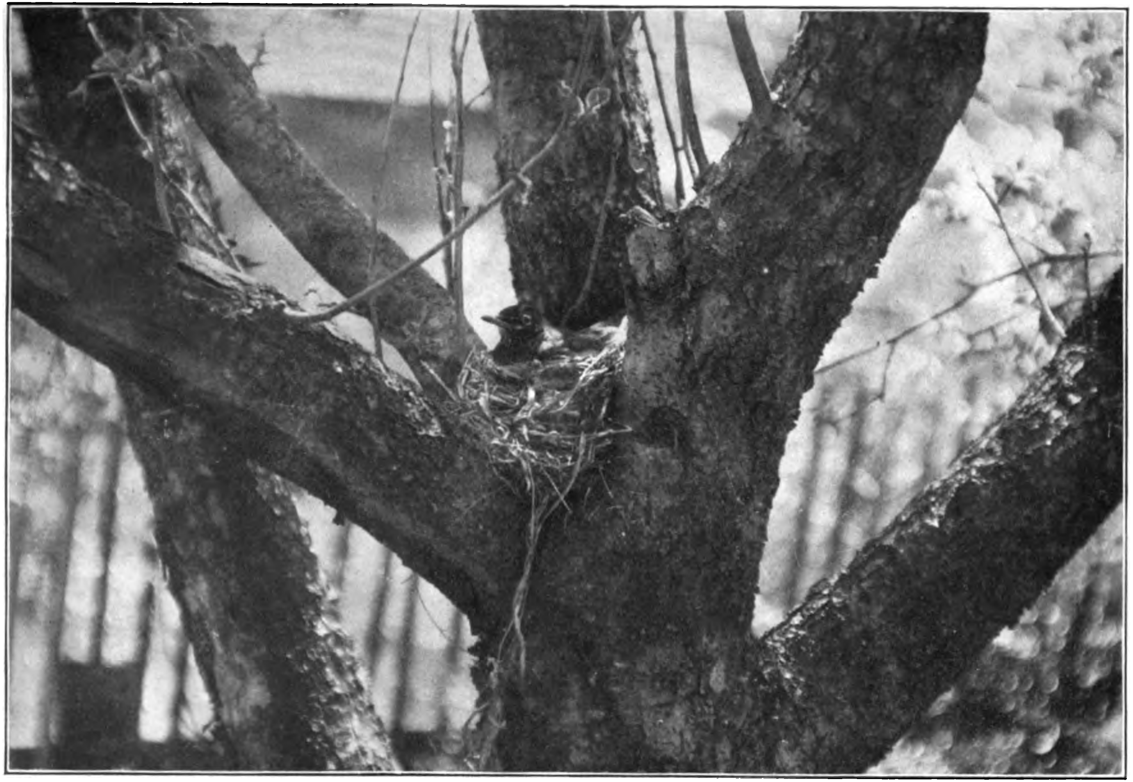
1. Geol. of Wis., I. p. 475.



AMERICAN ROBIN ON NEST.

Photo. by F. E. BURROWS.

HYPOTHETICAL LIST.

Cepphus sp? GUILLEMOT.

We are confident that some species of guillemot occurs on Lake Superior in winter, and possibly also on northern Lake Michigan. There is no positive evidence of a specimen ever having been taken in Wisconsin waters, however. While on Lake Superior we made diligent inquiry among people who had reasons for knowing, and several spoke of a small white "duck," seen in winter. One man in particular was very positive in regard to a duck "big as a teal and speckled in rings all over" that frequented Whitefish Bay in winter. This inelegant description fits the winter plumage of either *C. grylle* or *C. mandtii* very well. Dr. S. Kneeland, Jr., of Boston, makes mention, in his list (1) of the Birds of Keweenaw Point, Lake Superior, of the reports of a nearly white merganser or "saw-bill" in that vicinity in winter. He did not think it likely that it could be *Mergus albus*, and as no specimens were procured he was inclined to think "the bird was some white plumaged duck." We think it probable that these birds will prove to be some guillemot, in winter plumage. The occurrence of several other species of *Alcidae* on Lake Superior, as noted in some Michigan lists needs verification.

Rissa tridactyla *(Linn.)*. **KITTIWAKE.**

This species has been given a place in former Wisconsin lists on the evidence of Dr. Hoy alone. In an early day Hoy stated that this bird was "met on the lake November, 1853," but later, in December, 1870, he had the opportunity to carefully observe with a strong glass a single individual which remained about Racine harbor for a number of days. An account of this is given in Nelson's Birds of Northeastern Illinois and more fully in a letter later to L. Kumlien. We have no doubt that the doctor's identification of this bird was correct, but it is hardly evidence enough to include the species in the list, as we are not aware of any specimen having ever been taken. We examined a young of the year, mounted, at Ashland, which was said to have been shot among the Apostle Islands, but the party owning it, a Canadian, was recently from the St. Lawrence River country, and this record is considered of no value.

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1. Proc. Bos. Soc. Nat. His., 1856, p. 239.

Gelochelidon nilotica *(Hasselq.).* **GULL-BILLED TERN.**

Included in Dr. Hoy's list of 1852 with the simple statement: "We have but seldom met the marsh tern in this vicinity." Nelson, in Birds of Northeastern Illinois, says: "An exceedingly rare visitant during summer." Various Michigan lists give it as "often abundant on Lake Michigan," "common, Saginaw River in January," etc., etc., all of which is too absurd for serious consideration. We know of no actual record for Wisconsin, and have never seen the bird in the north.

Sterna maxima *Bodd.* **ROYAL TERN.**

The only reference to this species as a bird of Wisconsin that we know of is that of Dr. Hoy, who in his list of 1852, says "rarely visits us," and is later quoted by Nelson (1) as authority for the statement that "a specimen was taken at Milwaukee many years ago and preserved in a museum there." We very much doubt if this species should be retained as a Wisconsin bird. Dr. Hoy does not mention *caspia,* which makes us suspicious that the specimen referred to was of that species. Furthermore we carefully went through the Natural History Society's collection at Milwaukee a number of times between 1873 and 1875, and although there used to be an old specimen of *caspia* there, we never saw or heard of a specimen of *maxima* (L. K.).

Procellariidæ? PETREL.

There is a belief among lake captains and others that some species of petrel is found at times on Lake Michigan. We are very much inclined to doubt it, however, and there are no records to substantiate their statements.

Anhinga anhinga *(Linn.).* **ANHINGA.**

In a paper on some of the rarer birds of Dodge County, Wisconsin, by W. E. Snyder (2), the author includes this species as having "been shot by a Mr. Chatfield some twenty years ago," and "described" to Mr. Snyder by him. As we consider this no evidence whatever that this strictly southern species ever visits us, we cannot accord it a place in our list.

Phalacrocorax carbo *(Linn.).* **CORMORANT.**

We have investigated several reports of *P. carbo* having been taken in the state, but have never found a record worthy

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1. Birds of N. E. Illinois, 1877, p. 147.
2. Bull. Wis. Nat. His. Soc., April, 1892.

of a moment's consideration, and do not think the species ever even straggles to our border.

Branta leucopsis *(Bechst.).* **BARNACLE GOOSE.**

In the Wisconsin Agricultural Report, 1852, Dr. Hoy reports having seen a barnacle goose in Racine harbor in December, 1850. The bird referred to by Dr. Hoy, we personally and positively know, was *Chen cœrulescens,* a bird at that time, of course, unknown to the doctor.

Tringa ferruginea *Brünn.* **CURLEW SANDPIPER.**

Given in Barry's list of 1854 as "at one time quite common" in the vicinity of Racine, but "has entirely disappeared." It is almost unnecessary to state that this must be an error. He no doubt refers to some other wader, possibly to *Micropalama himantopus,* as this species is not included in his list, although given by Hoy two years previous from the same locality.

Catharista uruba *(Vieill.).* **BLACK VULTURE.**

We do not consider the records of this species for Wisconsin sufficiently authentic to warrant us in giving it a place at the present time. Will no doubt straggle to the state some time, *via* the Mississippi River.

Ictinia mississippiensis *(Wils.).* **MISSISSIPPI KITE.**

From the fact that no specimen of this bird has ever, to our knowledge, been actually taken within the borders of the state we must place it among those which will some day without doubt be added to our list. The A. O. U. Check-List and other works of authority give the species as casual in Wisconsin, doubtless on the authority of Dr. Hoy's note of having "seen" a specimen in 1846. Thure Kumlien was sure of having seen it, and we are equally sure ourselves. It is remarkable that all the birds "seen," though ranging in time from July, 1846 (Hoy) to August, 1870 (L. K.) should have been on Rock River, within a few miles of the same place. Dr. Hoy's surmise that it is occasionally met on the Mississippi River, is possibly correct. Mr. Skavlem, of Janesville, is quite positive that he shot a specimen of this kite when a boy, many years ago in Rock County, but prefers that he be not made responsible for the record, as there is possibly a doubt, although he admits that he is himself positive in regard to the identification. A specimen mounted for the Oshkosh Normal

School was secured from a local taxidermist, who said it was shot at Lake Koshkonong. Later developments, however, failed to verify this.

Falco (Hierofalco) sp. GYRFALCON.

Some species of gyrfalcon has been credited to the fauna of Wisconsin in an early day, a thing by no means impossible or unlikely; but there is no actual record obtainable at present. There was formerly a specimen preserved at Oshkosh, which was said to have been killed near Lake Winnebago.

Falco mexicanus *Schleg.* **PRAIRIE FALCON.**

An intimate friend of Thure Kumlien's, and a very close observer of birds, often spoke of a hawk which he said was very close to the duck hawk, and was quite annoying in chicken shooting on the larger prairies at an early day. He secured a specimen in the fall, sometime in the early sixties, that came into the possession of Thure Kumlien in a badly decomposed state, but was preserved. This bird was never satisfactorily identified otherwise than as a young prairie falcon, which it probably was. The specimen, however, is not at our command at present, and we cannot give the species a place in the list, though quite sure of the identity.

Empidonax virescens *(Vieill.).* **GREEN-CRESTED FLYCATCHER.**

We have never taken this species in Wisconsin, and all the observers with whom we have had correspondence have also failed to find it. Hoy and some later writers include it in their lists, but evidently without positive proof. The fact that Hoy appears to have been somewhat mixed on his flycatchers, as indeed many at that time were, and that all recent collections fail to produce a specimen, although furnishing both varieties of *traillii*, whereas Hoy included but one, of course, leads us to believe that a mistake has occurred, and we await future developments.

Centronyx bairdii *(Aud.).* **BAIRD'S SPARROW.**

This species has been credited to Wisconsin, and though it is by no means impossible that it might occur, the record in question is open to suspicion, as the balance of the skins in the box, some twenty in number, were taken near Vermillion, South Dakota.

Junco aikeni *Ridgw.* **WHITE-WINGED JUNCO.**

In the Auk for January, 1885, page 32, Prof. W. W. Cooke records a specimen of this bird from Jefferson, Wisconsin, January 14, 1883. In answer to our inquiries for more information regarding the capture, Mr. Cooke states that he now has considerable doubt of his record, and does not consider the species entitled to a place in a Wisconsin list on his evidence.

Vireo belli *Aud.* **BELL'S VIREO.**

This bird has been taken within a few miles of the Wisconsin line in Illinois, and near Chicago, by Nelson. Although it has been credited to the fauna of Wisconsin the proof is still lacking. A specimen sent to us for the purpose of verifying the record proved to be *V. noveboracensis.* In the early forties Thure Kumlien procured specimens of a vireo which he called *belli*, of which he had no description, simply to distinguish it from *gilvus.* This led to some confusion with Lawrence, Baird, and others who had not seen the specimens. The bird referred to was later described by Cassin as *V. philadelphicus.*

Dendroica kirtlandii *Baird.* **KIRTLAND'S WARBLER.**

We regret that there is no actual record for the state of this rare warbler. All lists, and the best of authorities, include Wisconsin in the geographical distribution of the species, but on no better evidence, so far as we know, than that Dr. Hoy once "saw it." We do not doubt this in the least, but it hardly makes a record to be so widely quoted. Dr. J. M. Wheaton (1) in speaking of the species soon after its discovery says: "These two are the only individuals discovered, unless it be one shot by Prof. Hoy, of Racine, Wisconsin," but later (2) simply states that "Dr. Hoy thinks that he has seen it at Racine." In Hoy's list of 1852 he simply says: "I met one single individual of this recently discovered species, at Racine, May 20, 1853." Thure Kumlien, during fifty years' residence in Jefferson County, near Lake Koshkonong, and in one of the best warbler territories in America, would not admit that he was ever sure of having seen it. The same was our experience until May 24, 1893, when we stood watching an unusual number of warblers, flitting from bush to bush across a willowy marsh near Lake Koshkonong, and scattering as they reached the higher trees. We were wondering how some of our migration experts would

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1. Ohio Ag. Report, 1860, Second Series, p. 374.
2. Geol. Surv. of Ohio, Vol. IV, 1882, p. 264.

have estimated the number of each species, when directly in front of us, and not ten feet away, we saw what we still believe was a fine adult male of Kirtland's warbler. We stepped back a pace or two and fired. Then followed an exciting race back and forth, through, under, and over a barb-wire fence, among weeds, brush, ditches and springs until we were nearly exhausted. The bird could almost fly, and when, by a master stroke, we captured him, and in handling such a rarity as one would naturally do, he escaped, we were unable to dislodge him from the immense brush pile where he sought safety. Thus, though we are positive in our own mind, of having seen, shot, and even handled a specimen of Kirtland's warbler, we have no record. The bird has been taken in Michigan, Illinois, and Minnesota, and it is probably only a question of time before some fortunate Wisconsin ornithologist can add it to our list with an authentic record.

Thryomanes bewickii *(Aud.)*. **BEWICK'S WREN.**

This species has been credited to Wisconsin, but we think on insufficient evidence. We are unable to find an authentic record of an actual capture. Grundtvig was in error when he thought it "must surely be found at Shiocton" (Outagamie County).

Ixoreus nævius *(Gmel.)*. **VARIED THRUSH.**

We are under the impression that Hoy recorded a single specimen of this species as captured by himself at Racine, but are at present unable to find the reference, and have no personal knowledge of the capture.

Sialia arctica *Swains.* **MOUNTAIN BLUEBIRD.**

Dr. Hoy examined a specimen of this species in a local collection, which was said to have been shot in Wisconsin, across the river from Dubuque, Iowa. In a personal letter to L. K., he says: "There can be no doubt of this record," and adds that a "second specimen was taken near La Crosse late in the autumn of 1856." He did not see the last mentioned specimen, however. Until one of these specimens, at least, is brought to light again, we do not feel like including the species on this slight evidence. It is included in Dr. Kneeland's list (1856) of the Birds of Keweenaw Point, Lake Superior.

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BULLETIN
OF THE
WISCONSIN NATURAL HISTORY SOCIETY

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MILWAUKEE, WISCONSIN.

THE EDW. KEOGH PRESS, MILWAUKEE

The Wisconsin Natural History Society,

MILWAUKEE, WISCONSIN.

ORGANIZED MAY 6, 1857.

OFFICERS AND DIRECTORS.

Edgar E. Teller, President	165 27th Street, Milwaukee.
Henry L. Ward, Vice-President	Public Museum, Milwaukee.
Charles T. Brues, General Secretary	Public Museum, Milwaukee.
William Finger, Treasurer	297 12th Street, Milwaukee.
Dr. Sigmund Graenicher	551 7th Street, Milwaukee.

PUBLISHING COMMITTEE.

Henry L. Ward, Geo. W. Peckham,
Chas. E. Monroe.

REGULAR MEETINGS.

These are all held on the last Thursday of each month, except July and August, in the lecture room in the Museum-Library Building, Milwaukee.

PUBLICATIONS.

The "Bulletin of the Wisconsin Natural History Society."

MEMBERSHIP DUES.

City Members, $3.00 per annum; Non-resident Members, $2.00 per annum; Life Members, one payment of fifty dollars.

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 3, New Series. NOVEMBER, 1905. No. 4.

PROCEEDINGS.

September 25, 1902.

President Teller in the Chair.

In the absence of the general secretary Mr. Adolph Biersach was chosen temporary secretary.

Applications for membership were received from the following persons: Emil S. Weisse, Elcho, Wis.; Erskine E. Bailey, Little Rapids, Wis.; Frederick F. Jahn, Ironwood, Mich.; Glenn W. Camp, Mukwonago, Wis.; Henry Severing, University of Wisconsin, Madison, Wis.; Clarence Olen, Winneconne, Wis.; Nic. H. Terens, Mishicot, Wis.; Ephraim D. Oswald, Mishicot, Wis.; Lafayette Ellerson, Big Bend, Wis.; E. W. Beebe, Milwaukee; H. E. Haferhorn, Milwaukee; and Carl Biersach, Milwaukee.

The name of Clarence B. Moore of Philadelphia, Pa., was proposed by the Archæological section for honorary membership.

These applications were referred to the directors for action.

Mr. Louis Lotz gave an informal account of a trip taken by him the past summer to Montezuma Co., Colorado, and to the mesa or table-land region of the cliff dwellers. At the conclusion of his remarks the speaker was invited to prepare a fuller account of his trip, to be read at a subsequent meeting of the society.

October 30, 1902.

President Teller in the Chair. Twenty-five members present.

Mr. A. Biersach gave a report of the meeting of the Biological sections held Oct. 9th.

Mr. C. E. Brown gave a report of the meeting of the archæological section held Oct. 23rd.

The secretary then gave an extended account of the asters of eastern Wisconsin illustrated by a series of specimens collected during the present autumn.

Applications for membership were received from Messrs. Henry L. Ward, Charles Koubeck, and Dr. J. C. Lange, all of Milwaukee.

November 28, 1902.

President Teller in the Chair. Sixty-five persons present.

Mr. C. E. Brown presented a report of the last meeting of the archæological section at which papers were presented by Miss Lapham, Dr. Peet and Mr. Gerend.

Applications for membership were received from the following: Howland Russell, Dr. John Madden, Wm. Segall, Dr. Carl Bruck, James K. Mazak, Chas. Quarles, J. W. S. Tomkiewicz and Fremont Utter.

The President referred to the unfortunate omission of the name of one of the oldest and most esteemed members of the archæological section from the published list of members.

Mr. Louis Lotz then read an interesting and extended account of a trip undertaken by him in August and September of the present year to the Mesa Verde in southwestern Colorado and of his investigations and explorations among the famous canyons and ancient cliff dwellings of that region.

At the conclusion of his address a vote of thanks was given unanimously to the speaker upon the motion of Mr. H. A. Crosby.

Mr. Charles H. Doerflinger presented some important and interesting notes of recent archæological discoveries in southern France. He mentioned the discovery in the caves and grottos of this region of sculptures and engravings in ivory, horn and bone, representing both animals and human beings; and particularly the quite recent discovery upon the walls of the grottos themselves of both incised and painted representations of animals, including the bison, reindeer and horse, believed to have been contemporaneous in execution with the sculptures and engravings upon bone and ivory. The age of all is placed at from 10,000 to 12,000 years before the Christian era. The speaker, also called attention to the fortunate joining of forces in France by archæologists and geologists and to the desirability of such harmony of action in other countries and in Wisconsin.

December 18, 1902.

President Teller in the Chair.

Mr. Adolph Biersach presented a report of the biological section meeting held Dec. 11. At this meeting Mr. Wm. Vogel exhibited cases of butterflies from India; Dr. S. Graenicher, fresh water shells from Douglas County; and Mr. Wm. H. Elkey gave an account of the method of collecting shells from the Mississippi river for the manufacture of buttons.

By request, the University of Rennes, France, was placed on the exchange list of the society.

Dr. Ernst Hautke and Dr. J. F. Snyder were proposed for active membership and Dr. François Daleau of Bourg sur Gironde, France, was proposed as an honorary member.

Miss Harriet B. Merrill then favored the meeting with an entertaining account of a trip taken by her the preceding summer and fall, in the course of which she visited the cities of Pernambuco, Bahia, Rio de Janeiro, sâo Paulo and Santos in Brazil, Buenos Aires in Argentina and Ascension in Paraguay, including a brief account of each of these places and of a steamboat trip up the Para and Paraguay rivers.

January 29, 1903.

President Teller in the Chair. Eighty persons present.

Mr. Adolph Biersach reported an informal meeting of the general sections held on Dec. 8th.

Mr. C. E. Brown presented a report of two meetings of the archæological section, held on Dec. 29, and Jan. 16, at each of which a number of papers were presented on subjects of interest.

Requests were received from several libraries to exchange with the society. These were granted.

Applications for membership were received from the following: Oscar Altpeter, Alfred Fischer, Robert Wild, and Wm. Orth. Mr. H. L. Ward, the director of the Public Museum then read an interesting and comprehensive paper, illustrated with stereopticon slides on "Meteors and Meteorities."

February 26, 1903.

President Teller in the Chair. Twenty-five persons present.

Mr. Adolph Biersach reported a meeting of the biological sections held Feb. 12, at which Messrs. Finger, Brown, Lotz, and Teller took part in the proceedings.

Mr. Charles E. Brown reported a meeting of the archæological section held Feb. 20, at which papers were read by Prof. Wm. H. Beach and Miss Julia Lapham; and papers by J. T. Reede of Calumet, Mich., and W. R. Moorehead of Andover, Mass., were read by members present at the meeting.

Applications for membership were received from the following: H. W. Frieden of Mineral Point, Wis., and H. P. Severin of Winneconne, Wis.

A paper by Ernst Bruncken on the flora of the lake shore region of Milwaukee County was read by the secretary.

March 26, 1903.

President Teller in the Chair. Fifty persons present.

Mr. Frank Collins Baker, curator of the Chicago Academy of Sciences then delivered a lecture, illustrated with stereopticon slides upon the subject "Snails; How and Where they Live."

At the conclusion of the address, the president expressed the thanks of the society to the lecturer.

April 30, 1903.

Annual meeting. President Teller in the Chair.

Dr. F. C. Mock read a paper on the subject "Comparative Anatomy and Evolution", showing how the obscurities presented by individual ontogeny are elucidated by the study of comparative anatomy, and how the doctrine of evolution is supported by both.

The President extended the thanks of the society to the lecturer for his able and interesting address.

The Treasurer presented his annual report, summarized as follows:

Balance on hand April 24, 1902	$103 11
Cash received during the year ending April 30, 1903	347 90
	$451 01
Total disbursements for the year	$396 35
Cash on hand April 30, 1903	54 66
	$451 01

The Secretary presented a verbal report. Both reports were accepted.

The Secretary then reported on the meeting of the biological sections held April 9th.

The next order of business being the election of officers, Dr. G. W. Peckham nominated all the present incumbents for the same offices and moved that Dr. S. Graenicher be directed to cast the unanimous vote of the society for their reelection. The motion was carried and the following officers declared reelected. President, E. E. Teller; Vice-president, Dr. C. D. Stanhope; Treasurer, L. R. Whitney; Director, C. E. Brown; General Secretary, C. E. Monroe.

The Secretary reported that the directors had voted to recommend the amendment of by-law I so as to make the annual dues of non-resident members $3.00, or the same as those of resident members. The motion was lost.

Dr. S. Graenicher then moved that the by-law be amended so as to make the annual dues of non-resident members two dollars in place of one. This motion was carried.

The Secretary then read a letter from Mr. Henry A. Crosby, president of the newly organized Wisconsin Archæological Society, announcing the formation of the latter society and requesting for it the privilege to assume the publication of the "Wisconsin Archeologist."

On motion of Dr. Peckham, it was voted that this be granted.

June 4, 1903.

The regular May meeting, postponed. President Teller in the Chair.

Dr. John Madden gave a very interesting account of his observations on wild red foxes on the Door County Peninsula, describing their habits and relations to men and domestic animals.

September 24, 1903.

Dr. G. W. Peckham in the Chair. Seventeen persons present.

The resignation of Mr. L. R. Whitney as treasurer was presented.

The name of Miss F. Schnellenmeyer was presented for membership.

Mr. Wm. Finger exhibited a large number of flowering plants collected in the course of a trip to the Yellowstone Park. Many specimens of different orders from high altitudes exhibited the same tendency toward strong development of the underground portions with stunting of the upper parts.

The Secretary presented a few specimens of asters collected at Kaukauna and High Cliff, Wis., and offered for examination the advance sheets of Kumlein and Hollister's "List of Wisconsin Birds" soon to be issued by the society.

Miss Harriet B. Merrill spoke of the work upon which she had been engaged of studying and identifying the Crustacea collected by her during her South American trip.

Dr. Graenicher spoke of his investigations among the solitary bees of the genus *Halictus*, and gave an interesting account of their habits, especially of a semi-social species, many specimens of which occupy the same underground tunnel, each female digging off from that her saparate apartment and taking turns at keeping watch of the nest-opening.

Mr. C. E. Brown exhibited a specimen of the edible fungus, *Polyporus frondosus*; and also half a dozen species of dragon flies new to Milwaukee County, there having been collected about 70 species in the county.

Dr. Peckham spoke of the habits of the solitary wasps is stinging or mutilating their prey and discussed the question as to whether there was any other motive or reason for this other than that of making transportation easy by preventing resistance or removing limbs which might cause friction. He inclined to the opinion that this was the only object sought.

Mr. Brown gave notice of the recent death of Dr. Ernest Hautke, a member of the society and moved that a committee be appointed to prepare suitable resolutions. Mr. Brown and Mr. Altschwager were appointed such committee.

October 29, 1903.

President Teller in the Chair. Mr. C. L. Mann Secretary *pro tem.*

The following resolution was adopted:

Resolved, That in the death of Mr. Ernest Hautke, a member of the Wisconsin Natural History Society, this society has lost a valuable member who liberally gave his time and thought to promote its success.

Resolved, That a copy of this resolution be forwarded, with assurance of our deep and respectful sympathy to the afflicted widow and family of the deceased.

Mr. Adolph Biersach presented a report of the meeting of the biological sections held October 15th.

The resignation of Mr. L. R. Whitney was accepted and Mr. Wm. Finger elected to fill the vacancy.

Mr. Adolph Biersach then read a paper on the cultivation of the banana and plantain. This was followed by a general discussion and reference was made to the question of the cultivation on this continent of the Manila hemp plant, a species of *Musa.*

December 3, 1903.

President Teller in the Chair.

Mr. I. N. Mitchell and Dr. James Zawady were proposed for membership, and elected.

Mr. Henry L. Ward gave an informal account of his late visit to the Pacific coast. Mr. C. L. Mann spoke of the trees and wild animals of the woods of northern Wisconsin and Michigan.

January 28, 1904.

President Teller in the Chair.

Mr. Walter S. Hummel was presented for membership.

Dr. S. Graenicher read an able and interesting paper on parasitism among our wild bees. Miss Denton, Dr. Case and Mr. Ward took part in the discussion which followed.

March 3, 1904.

The postponed February meeting. President Teller in the Chair.

Dr. E. C. Case favored the meeting with an interesting explanation of the newly propounded "Aggregation theory of World Building." Many members took part in the discussion which followed.

March 31, 1905.

President Teller in the Chair.

Mr. H. L. Skavelem of Janesville, favored the society with an interesting paper on "The food of the Canvas-back Duck on Lake Koshkonong, giving the results of his own investigations, and showing the food of the duck to be the seeds of species of *Potamogeton.*

April 28, 1904.

The annual meeting. President Teller in the Chair.

The report of the Treasurer was read and approved and on his motion an auditing committee was appointed consisting of Messrs. Graenicher, Russell and Case.

A nominating committee consisting of Messrs. Peckham, Graenicher and Ward was appointed and reported as follows: For President, E. E. Teller; Vice-president, H. L. Ward; Secretary, C. E. Monroe; Treasurer, Wm. Finger; Director, C. E. Brown. As Mr. Brown expected to be absent from the city Dr. S. Graenicher was put in his place, and the ticket elected by unanimous vote resulting as follows: President, E. E. Teller; Vice-president, Henry L. Ward; Secretary, C. E. Monroe; Treasurer, Wm. Finger; to Board of Directors, Dr. S. Graenicher.

The general Secretary gave an address on the subject: "Some Factors of Evolution." Messrs. Peckham, Russell and Ward joined in the discussion that followed.

The name of H. L. Skavlem was proposed for membership and he was elected.

May 26, 1904.

President Teller in the Chair.

Mr. Adolph Biersach, Secretary of sections reported a meeting of the biological sections held May 12, when the following officers were elected for the ensuing year. Directors: Botanical Section, Howland Russell; Geological Section, C. E. Monroe; Palæontological Section, E. E. Teller; Ornithological Section, H. L. Ward; Entomological Section, Dr. S. Graenicher.

Dr. George W. Peckham then delivered an informal address on the subject of "Animal Behavior", in which he discussed the nature of animal intelligence and the distinction between intelligence and instinct. Messrs. Graenicher, Case and Ward took part in the discussion which followed.

June 30, 1904.

President Teller in the Chair.

Mr. H. T. Jackson of Milton, was elected a member of the society.

Mr. Ernest Bruncken gave an extended description of the "Forests of the Southern Appalachians", including the forest conditions of the region and the method of reforesting employed on the Biltmore property.

September 29, 1904.

President Teller in the Chair.

Mr. H. L. Ward exhibited skins of two subspecies of the Gray Squirrel, *Sciurus carolinensis leucotis* of the eastern province and *S. c. hypuphœus* of the western. Both occur together in Racine County, showing that this locality is the boundary line between the ranges of the two forms.

Mr. Ward also exhibited a series of casts of skulls beginning with that of *Pithecanthropus erectus*, from the Tertiary of Java, and including those of the Neanderthal man and the man of Spy, and ending with dolichocephalic and brachycephalic human skulls of the present time, showing the character of the first in the series to be intermediate between the simian and human types.

Mr. C. E. Monroe exhibited specimens of *Aster diraricatus* L. and *A. lcptocaulis* Burgess, showing the difference between the former or eastern species and the latter which is common in eastern Wisconsin. He also showed a series showing the relationship between *A. azureus* Lindh, and *A. l ris* L. as proved by resemblances between both flower heads and leaves in variant forms of the two species.

October 27, 1904.

President Teller in the Chair.

Mr. C. E. Brown read a detailed and interesting account of the display of exhibits of the Philippine Islands at the Louisana Purchase Exposition at St. Louis.

December 1, 1904.

President Teller in the Chair. Howland Russell Secretary *pro tem.*

Dr. S. Graenicher read an interesting paper on "The Colors of Flowers and their relations to Insect Visitors."

December 29, 1904.

President Teller in the Chair.

Mr. W. J. Greenleaf gave an informal account of the methods of welding metals.

January 26, 1905.

President Teller in the Chair.

Mr. H. L. Skavlem of Janesville gave an account of his investigations on the food and food habits of the Canvas-back duck during the summer of 1904, illustrating his account with specimens of food plants obtained at Lake Koshkonong. A general discussion followed, participated in by Messrs. Russell, Finger, and Bartlett.

The President called the attention of the members to the very small attendance at the meetings of the society. A discussion as to the best methods of stimulating interest followed, participated in by Messrs. Bartlett, Ward, Skavlem, Russell, Finger and others. On motion of Dr. Bartlett it was voted that a committee be appointed to assist the existing permanent committee on programs in planning and providing lectures of a popular character. Messrs. Bartlett, Russell and Case were appointed on such committee.

February 23, 1905.

President Teller in the Chair.

Mr. H. L. Ward delivered an interesting and instructive lecture on the relations of the public to the Public Museum.

March 29, 1905.

President Teller in the Chair.

Mr. Chas. T. Brues, curator of invertebrate zoology at the Public Museum gave an interesting address, illustrated by stereopticon slides on "The Mexican Cotton Boll-weevil and the Cotton Bollworm."

Mr. H. L. Ward proposed the name of C. T. Brues for membership.

April 27, 1905.

Annual meeting. President Teller in the chair.

Mr. Finger presented his report as Treasurer for the past year.

Cash on hand April 28, 1904	$4 41
Cash received during the year ending April 27, 1905	240 16
	$244 57
Total disbursements for the year	$27 80
Cash on hand, April 27, 1905	216 77
	$244 57

The following officers were elected for the ensuing year: President, E. E. Teller; Vice-president, H. L. Ward; General Secretary, C. E. Monroe; Treasurer, Wm. Finger; to Board of Directors, Dr. S. Graenicher.

The name of C. G. Carpenter was proposed for membership.

Dr. E. C. Case delivered an address on "Oecological Features of Evolution".

The General Secretary called the attention of the society to the death of Horace Beach, a member of the society.

May 25, 1905.

President Teller in the Chair.

Mr. H. L. Ward moved that a committee be appointed to arrange for the publication of a bulletin. The motion was carried and Messrs. Ward, Peckham, and Monroe were appointed such committee.

Mr. Howland Russell gave a talk on the "Milwaukee Arboretum".

Mr. Henry L. Ward spoke on "Eolithic Implements", exhibiting an illustrative series recently obtained for the Public Museum from England.

SOME OBSERVATIONS ON THE LIFE HISTORY AND HABITS OF PARASITIC BEES.

BY S. GRAENICHER.

We are rather poorly acquainted with the habits of those bees, that lay their eggs in the nests of other bees, instead of constructing nests of their own. They figure under the name of inquilines or guest-bees, while the rightful occupants of the nests are called host-bees. Some writers invariably make use of the term "parasitic bees" when referring to guest-bees in a general way, although in at least one instance the larva of the guest-bee has been observed as a commensal in the nest of the host-bee, and not as a parasite. Our knowledge is especially deficient in regard to the fate of the egg or larva of the host-bee after one or more eggs of the guest-bee have been placed in the same cell together with the egg of the host-bee. In this respect I have been able to gather the following information from the literature. Packard, (1), in referring to nests of *Andrena* and *Halictus*, collected at Salem, Mass., by J. H. Emerton, states that both sexes of *Nomada imbricata* Sm., and several females of *Nomada pulchella* Sm., were found in the nests of *Andrena vicina* Sm., as also some specimens of *Nomada imbricata* in the cells of *Halictus parallelus* Say. According to Packard "there seems to be enough for *both* genera to feed upon, as the young of both host and parasite were found living harmoniously together, and the hosts and their parasites are disclosed at the same time."

Concerning the relations between the bumble-bee and its guest-bee *Psithyrus* I copy from Sharp, (2), the following. "The *Bombus* and *Psithyrus* live together on the best terms, and it appears probable that the latter do the former no harm beyond appropriating a portion of their food supplies. Schmiedeknecht says they are commensals, not parasites." Farther on Sharp remarks: "The cells in which the young of the *Psithyrus* are hatched are very much larger than those of the *Bombus* and it may therefore be presumed are formed by the *Psithyrus* itself." Fabre, (3), has come across from 2 to 12 eggs of the guest-bee *Stelis nasuta* in the nest of the much larger mason-bee *Chalicodoma muraria*. The several larvae of *Stelis nasuta* live frater-

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1. A. S. Packard. Guide to the Study of Insects, 6th Ed. (1878), p. 142.

nally side by side, devour the food supply of the host, grow rapidly and spin their cocoons before the host-larva has reached one-fourth of its size. According to Fabre's opinion the latter dies of starvation, but he has not been able to verify this by observation. In some cases he has found the dry remains of the mason-bee among the cocoons of the guest-bee, but he has just as frequently discovered nothing whatever of the mason-bee larva. There is another guest-bee *Dioxys cincta* that lays its eggs in the nest of *Chalicodoma*. Fabre, (4), has repeatedly encountered either the larva or the imago of Dioxys in the nest of the mason-bee, but never the slightest trace of the latter in the same cell. Verhoeff, (5), seems to be the only one who so far has witnessed, and described the attack of a parasitic guest-bee on the larva of a host-bee. The parasite in this case is *Stelis minuta* Nyl., inhabiting the nest of *Osmia leucomelaena* Kirby. The host-bee constructs her nest in dry blackberry stems by excavating the pith, and forming a tunnel in which a row of cells is placed, one above the other. Each cell is partly filled with the mixture of honey and pollen usually called "bee-bread," and is separated from the adjoining one by a partition made of pieces of green leaves chewed by the bee, so as to form a soft pliable mass. Verhoeff emphasizes the following points. 1. *Stelis minuta* deposits its egg earlier than the host-bee, and in the lower region of the bee-bread. 2. The larva of the parasite hatches a little earlier than that of the host-bee, whose egg is situated on top of the bee-bread. 3. Both larvæ, which at the beginning are of about the same size partake of the bee-bread, the host-larva on top, the parasite below. 4. The latter gradually increases in size, and consequently advances towards the host-larva on top. 5. Finally the parasite, which in the meanwhile has become twice as large as the host-larva comes in contact with the latter, kills it, and eats it. Verhoeff informs us that there was a mutual exchange of hostilities between the two larvæ, each trying to grab the other with its mandibles, but that finally the parasite succeeded in burying its mandibles in the head of the host-larva. The latter was eaten up within 1 or 2 days. This account given by Verhoeff has been considered somewhat in detail for the purpose of comparing his results with those obtained by me from observations made on *Stelis sexmacu-*

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2. D. Sharp. The Cambridge Natural History, Vol. 6, p. 59.
3. J. H. Fabre. Souvenirs Entomologiques, Vol. 3, p. 114.

lata Ashm. in the nest of ***Alcidamea producta*** Cress, a bee of the family *Osmiinæ.*

Sharp, (6), sums up the status of our knowledge of the doings of the larvæ of parasitic bees in the nests of host-bees. He says "in such cases the resulting larvæ eat and grow more quickly than the progeny of the host-bee, and so cause it to die of starvation. It has been observed that some of these parasitic larvæ, after eating all the store of food, then devour the larvæ they have robbed. In other cases it is possible that the first care of the parasitic larva, after hatching, is to eat the rival egg."

A number of observations made during the last 3 years on a few species of parasitic bees of our region (representing the genera ***Stelis, Coelioxys,*** and ***Triepeolus***) bring out several new points in this connection.

STELIS SEXMACULATA ASHM. A PARASITE OF ALCIDAMEA PRODUCTA CRESS.

The parasitic bee ***Stelis sexmaculata*** was described by Ashmead from specimens bred from the nests of ***Alcidamea producta*** collected by Davidson in the vicinity of Los Angeles, Cal. From Davidson's, (7), description of the nest we learn that the Californian *Alcidamea producta* builds its nest in the stems of the elder tree by excavating the broken twigs, and constructing of pith and clay the partitions between the cells, as also those near the opening of the nest (the "outer defence" as Davidson calls them). In our region this bee makes the partitions out of pieces of chewed leaves, and never uses clay for this purpose. In this variation of habits *Alcidamea producta* remains true to the habits in vogue within the family to which it belongs, since some species of ***Osmia*** utilize clay, while others resort to vegetable matter. On July 20, 1903, I witnessed at Cedar Lake, Washington County, Wis., a female ***Alcidamea producta*** obtaining her leaf material from a wild strawberry, ***Fragaria virginiana,*** situated about 3 m. from her nest. The leaves of this plant are rather hairy on the under side, and when thoroughly chewed they form a felt-like, pliable mass. ***Alcidamea*** flies in the surroundings of Milwaukee from the beginning of June to about the middle of August, and selects the dry stems of elder, blackberry, sumach, and other plants for nesting purposes.

The bee-bread in the nest of this bee is comparatively dry,

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4. J. H. Fabre. Loc. cit., p. 117.
5. C. Verhoeff. Zoologischer Anzeiger, Vol. 15, p. 41.

and forms a conical mass with the slightly curved egg of 2 to 3 mm. length on top. The newly hatched larva has its head directed downward towards the base of the bee-bread.

During the month of July, 1903, seven nests of this species, harboring the parasite ***Stelis sexmaculata*** either in the egg or larval stage were procured, partly from the surroundings of Milwaukee, partly from Cedar Lake (Washington Co.). Of the 24 cells in these nests 15 were infested by ***Stelis***, a percentage of 62.

In the following I offer a brief account of the observations made on one of these cells, as taken from my notes:

July 9, 1903.	Nest collected at Milwaukee contains 4 cells. Third cell (from below) with a parasite. On top of the bree-bread an *Alcidamea* larva, about 3 days old. On the side of the bee-bread, about half way up a ***Stelis*** larva feeding on bee-bread. It is smaller then the host-larva, and its head is directed upward, and towards the posterior end of the latter's body.
July 13.	The parasitic larva has grown considerably but is not as large as the host-larva. At 1 P. M. the parasite moves upwards a short distance, comes in contact with the host-larva, and secures a hold on the latter's side behind the middle of the body. The victim at first makes an effort to free itself, but offers no serious resistance. The parasite remains in the same position the whole afternoon, sucking the liquid contents of the host's body. The latter gradually perishes, and shrivels.
July 14.	The parasite has released its hold on the dead host-larva, and is feeding on bee-bread. It has lately increased very much in size. From now on the parasite does not pay any more attention to the remains of the host.

In the cell just considered a single parasite was present, but in a nest collected at Milwaukee, July 15, 1903, a cell was come across with 3 parasitic larvae, all of them on the same side of the bee-bread as the head of the host-larva. One of them was situated above the middle, not far below the host-larva, the second was lower down and directed laterally and the third was below the second and quite close to it. In the evening the third parasite, which throughout the day (July 15), had been partaking ~~of~~ bee-

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6. D. Sharp. Loc. cit., p. 20.

bread and growing in length reached the second and killed it. Four days later this same parasite killed the uppermost one and fed on its contents. Two days after this (July 21), the surviving parasite killed the host-larva. Both were about equal in size.

From the study of these 2 infested cells, as also of the remaining material at my disposal, we are presented with several noteworthy facts concerning the instincts of this particular parasitic larva. The most conspicuous feature is the pronounced aggressive tendency of the larva of *Stelis sexmaculata* as compared with the rather tolerant demeanor of the host-larva. It is superiority in size and strength that wins the victory in the case of this parasite. At the time of the attack the parasite was usually decidedly smaller than the host. In one instance (nest found at Cedar Lake, Washington Co., July 24), the host was at least four times as large as the parasite, and still the latter seized the host behind the head, and held on as successfully as any of the larger ones. In this case, after the parasite had been allowed to suck for a few minutes a slender pin was passed between the head of the parasite and the body of the victim, and the former forced to release its hold. This was done for the purpose of witnessing the effects of the bite, as also the subsequent behaviour of host and parasite. The host-larva withdrew the front part of its body by unsteady, swaying motions (similar to a human being in a dazed condition) but it gradually resumed its former position on the bee-bread. A small drop of yellowish fluid oozing from the skin behind the head indicated the point of attack. Before long it again came into dangerous proximity to the parasite, whereupon the latter by a quick motion regained its hold in nearly the same spot as before. The host-larva made some lively attempts to get rid of the aggressor, but undertook nothing in the way of a counter attack.

Whenever two larvæ of the parasitic bee *Stelis sexmaculata* are brought together in the same cell they begin hostilities as soon as they come in contact with each other. The one that secures the first hold survives, and the victim is subjected to the same treatment as the larva of the host-bee.

The behaviour of the larvæ of host-bees when brought in contact with each other in the same cell differs greatly from that of the larvae of parasitic bees. I have experimented along this line with the larvæ of several species of host-bees, and have not yet seen one of the larvæ injured by its neighbor, although un-

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7. A. Davidson. Entomological News, Vol. 7, p. 316 (Sept., 1896).

der certain circumstances the larvæ of one of the species were observed attacking each other. Undoubtedly the degree of tolerance varies in the different species. The most tolerant of the species under consideration proved to be *Ceratina dupla* Say, a bee suffering to a great extent from the presence of two Ichneumonid parasites in its nests. The tolerance displayed by its larva towards the larva of one of these Ichneumonids (*Habrocryptus graenicheri* Viereck) has been pointed out in a previous paper. (8.)

On July 9th, 1903, several cells of *Ceratina dupla* were provided each with two eggs, without increasing the food supply. In two of the cells the larvae lived long enough to develop into pupae on August 4th, and from one of these cells two female bees made their appearance, from the other a male and a female. These specimens were naturally much smaller than the average bee of this species since the larvae had been brought up on half rations. Not one of these larvae, while living close together, was ever seen to make an attack on the other occupant of the cell. This was not even done at the critical period when the food supply had become exhausted before the larvae had reached their normal development.

Four larvae from a nest of the leaf-cutter bee, *Megachile infragilis* Cress. procured at Cedar Lake, Washington Co., on August 1st, 1905 were experimented with in the same manner as the *Ceratina* larvae. They never attacked each other. But when the two larvae in the comparatively narrow cell had grown to such an extent that there was not room enough for both of them, one was crowded out by the other, and died. This happened in both cells under observation.

From a nest of *Osmia atriventris* Cress., found in the same locality, and on the same date, three larvæ of different size were taken out of their cells, and placed on a portion of bee-bread. They were brought face to face to each other, and so close together as to be in each other's way, especially after increasing in size. These larvæ never showed any signs of hostility towards each other, but arranged matters by taking up new positions on the bee-bread so as to interfere less with each other when feeding.

The results obtained with the larvæ of *Alcidamea producta* differed in some respects from those discussed above. Being well supplied with material I was enabled to make repeated experiments with these larvæ last summer (1904), as also this year.

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8. S. Graenicher. Entomological News, Vol. 16, p. 43 (Febr., 1905).

During the early part of their life the larvæ of this species live quietly side by side, but they gradually become less tolerant, and from the age of 5 or 6 days on they often grab each other with their mandibles when in close contact. On several occasions I have seen one of them secure a firm hold on another's body, and toss it around, without, however, puncturing the skin, or making any attempts at feeding on the one attacked. Under these circumstances the larvæ become very restless, do not feed normally, and die before reaching their full development.

Through the fact that the attack of the *Alcidamea*-larva does not produce any visible injury, while the bite of the parasitic larva of *Stelis sexmaculata* punctures the skin of the host-larva I have been led to examine the mandibles of the two larvæ. In the parasite the mandible is simple and sharp-pointed, (Fig. 3), in *Alcidamea* the apex of the mandible is broad and cleft (Fig. 2), and this difference in structure explains the difference in the result of the bite. The sudden attack of the parasite has evidently also much to do with the outcome.

An examination of the mandibles of several other species of host-bees gave the following information. ***Osmia atriventris***, Cress., *Megachile infragilis* Cress. and *Ceratina dupla* Say. have larvae with cleft (bidentate) mandibles, while in *Calliopsis andreniformis* Sm., and *Prosopis pygmæa* Cress. the mandibles are simple.

There is a difference in the degree of tolerance as displayed by the larva of the host-bee *Ceratina* on one side and that of the host-bee *Alcidamea* on the other, but even in the latter case the actions of the larva have hardly anything in common with those of the parasitic larva of *Stelis sexmaculata*. The *Alcidamea*-larva is not hostile during the first days of its existence, and later on it attacks only when stimulated by close contact with a neighboring larva. Furthermore its bite is ineffective, and is never accompanied by any sucking movements. In ***Stelis sexmaculata*** the biting instinct is in evidence from the beginning, and the larva is able to give up its original position on the bee-bread, and advance towards its victim. As a result of the bite the skin of the latter is pierced, a firm hold is secured, and sucking is begun at once.

The egg of *Stelis sexmaculata* (Fig. 1b), is mostly deposited near the base of the bee-bread, but occasionally higher up, and in one instance it was lying on top alongside of the host's egg (Fig. 1a). It is only half as long, and a trifle more than half as broad as that of the host, and accordingly the newly hatched parasite is about half as long, as the young host. When fully developed the larva of *Alcidamea* spins its cocoon, hibernates as a "resting larva," pupates in spring, and emerges some time in June. The same applies to its parasite *Stelis sexmaculata*, although its time of flight begins somewhat later than that of *Alcidamea.*

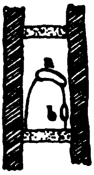
The habits of *Alcidamea producta* and its parasite *Stelis sexmaculata* agree in a general way with those of *Osmia leucomelaena* and its parasite *Stelis minuta* as described by Verhoeff, but in several important points they differ very decidedly. Verhoeff informs us that the larva of the parasite at first equals in size the host-larva, but that at the time of the attack it has become twice as large as the latter. He also states that after a combat has taken place between the two the host-larva succumbs to the attack of the larger, and more powerful parasite, and is eaten up by the latter in the course of a day or two.

The whole information derived from the study of *Alcidamea producta* and *Stelis sexmaculata* points to the aggressive instincts, and the sharp mandibles of the parasitic larva as the factors determining the fate of the host-larva. The size and strength of the parasitic larva have little, if any influence on the outcome. From the start the parasite is only one-half as long as the host, and at the time of the attack it may be of only one-fourth the length of the *Alcidamea*-larva, and still perform its deadly work with perfect success. The host-larva is doomed from the beginning. The encounter between the two is an extremely one-sided affair, and can not be called a combat, since the acts of hostility are evident on the side of the parasite only. The latter instinctively attacks any larva within its reach, and destroys a larva of its own kind in the same manner as it does the host-larva. If there be two or more parasites within the same cell all but one will have to perish. The victor invariably takes up a large portion of the liquid contents of the dead larva, but was never seen to eat up the latter entirely. Its essential food is the mixed supply of honey and pollen stored away by the host-bee. On this it feeds after leaving the egg, and to this it returns soon after the death of its victim.

BEES OF THE GENUS CŒLIOXYS IN THE NESTS OF LEAF-CUTTER BEES.

1. *Cœlioxys lucrosa Cress*. A parasite of Megachile addenda Cress.*

The leaf-cutter bee *Megachile addenda* selects the de-



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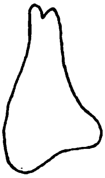

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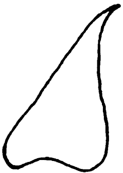

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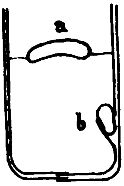

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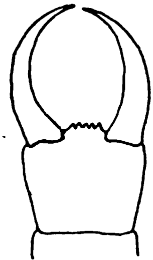

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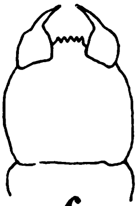

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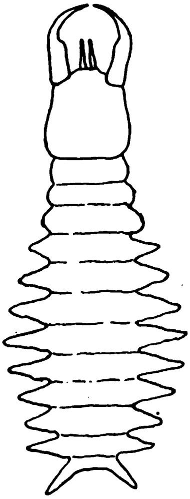

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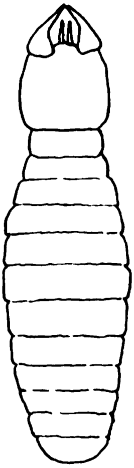

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serted burrows of coleopterous larvæ in partly decayed branches or logs laying on the ground. After clearing out such a burrow the bee proceeds to construct its cells with pieces cut out of green leaves in the manner characteristic of the leaf-cutter bees. Such a cell is about half filled with bee-bread, and an egg 5mm. in length deposited on the surface. One or more cells are constructed, and the opening of the nest filled with minute particles of chewed wood.

A nest of this species from the neighborhood of Milwaukee, was opened on September 3, 1903, and found to contain two cells, one of which as later events showed was infested by *Cœlioxys.* A visit of *Cœlioxys lucrosa* to this nest was noted the day before. The following gives an account of the happenings inside of the infested cell.

September 3, 1902.	Host-egg present, no parasite visible.
September 5.	The host-larva hatches in the afternoon.
September 8.	Host-larva alive, has grown considerably. Around noon the head of a second larva (*Cœlioxys*) with extremely long, slender, and curved mandibles (Fig. 5), makes its appearançe from out of the depth of the rather soft food-supply, biting aimlessly in different directions, and within a short time piercing the body of the host-larva. Later on the parasite withdraws, and feeds on bee-bread, opening and closing its long mandibles which seem to be rather unfit for this pupose. The attacks on the host-larva are renewed from time to time, and during these the parasite is seen sucking the body juices of the victim. The latter finally dies from the repeated attacks without ever having offered any noteworthy resistance. It does not seem possible that the larva of the leaf-cutter bee with its comparatively small mandibles could ever successfully resist an adversary armed with such formidable weapons of attack. The head of the parasite has a hard brown covering

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[*] This species seems to be *C. lucrosa*, Cress, but it may prove to be an undescribed species.

September 8.	which furnishes support to the enormous mandibles, and at the same time protects the head from an attack.
September 9.	The body of the dead host-larva has not been entirely eaten by the parasite.
September 12.	The *Cœlioxys*-larva has moulted. In its new form it has a white head with small mandibles (Fig. 6), and resembles somewhat the larva of the leaf-cutter bee. The large sickle-shaped mandibles, and the brown flattened head-shield have been entirely cast aside.
September 16.	The parasitic larva has gradually lost its former slender form, and looks much like a host-larva. The dry remains of the leaf-cutter larva are still in the nest.
September 18.	Parasite dead.

2. ***Cœlioxys rufitarsis, Sm., a parasite of Megachile melanophœa, Sm., and Megachile latimanus, Say.***

Megachile melanophœa constructs its cells in the ground, mostly not more than 6 or 9 cm. below the surface. A nest of this species was examined at Cedar Lake, Washington Co., July 13, 1903. The only cell in it was inhabited by a *Cœlioxys*-larva and not a trace of the leaf-cutter larva could be found. The parasitic larva in this case closely resembled the newly hatched larva of *Cœlioxys lucrosa* described above, and it passed through its first moult on July 16 with the same results as in the other case. On August 12, it pupated, and the bee *Cœlioxys rufitarsis* emerged September 4.

A nest of *Megachile latimanus*, another species nesting in the ground was visited by the parasitic bee *Cœlioxys rufitarsis* 3 times on the afternoon of July 13, 1903, also at Cedar Lake. The following day it was opened. It contained an unfinished cell with an egg of the parasite, 2½ mm. long but no egg of the host-bee. This egg of *Cœlioxys rufitarsis* hatched July 17, giving a duration of the egg stage of 4 days. The larva died before moulting on July 23.

Through this nest I became acquainted with the mode of oviposition of *Cœlioxys* which is quite unique in its way. With the sharp and rigid end of its abdomen the bee pierces the inner layer of leaves forming the cell, and into the slit thus formed it forces the egg. (Fig. 4b.) The latter is not of nearly equal width throughout as the egg of the average bee, but broadens out considerably at its anterior (cephalic) pole. On account of its peculiar shape the egg can not pass through the slit in its entirety. With its lower two-thirds it is resting between the inner and the adjoining layer of leaves while the upper portion protrudes slightly into the bee-bread. This mode of oviposition explains the purposes served by the characteristic structure of the conical sharp-pointed abdomen in *Cœlioxys*.

In the nests discussed above either a single egg or a single larva of the parasite *Cœlioxys* had been come across in the same cell, but at Cedar Lake on September 26, 1903 a nest of ***Megachile latimanus*** was found with 4 eggs of the parasite in one cell. They were not far apart from each other, but all of them were situated nearer to the bottom of the cell than to the surface of the bee-bread.

The host-bee *Megachile latimanus* extends its nest-building activity into the first half of October and its parasite *Cœlioxys rufitarsis* is still in evidence at this time of the year. On October 3, 1903, a female of this parasitic bee was captured at Milwaukee flying around an embankment in search of the nests of its host, and a dissection of this specimen brought 4 eggs to view, one of which was ready to leave the body, while the others were in different stages of development. This bee, our largest species of *Cœlioxys* is, as fe have seen a parasite of two species of ***Megachile*** that build their nests in the ground. It produces at least two broods a year, the bees of the first appearing around the beginning of July from hybernated specimens (probably passing the winter as larvæ), those of the second brood coming out about 2 months later. Besides the specimen reared from the nest of *Megachile melanophæa* I obtained an additional one from a nest of *M. latimanus* opened at Milwaukee on July 20, 1904. The larva in this case spun its cocoon on July 23, pupated on August 1, and emerged as a bee on August 20.

While the larva of *Stelis sexmaculata* the parasite of *Alcidamea producta* is equipped with simple and sharp, but not large mandibles, the larva of *Cœlioxys* leaves the egg with mandibles of enormous dimensions. These are very effective as weapons of attack but rather inconvenient for their owner when the latter is engaged in taking up food. Several days after the larva has appeared on the surface of the bee-bread, a period sufficiently long for the parasite to perform its deadly work, mandibles and head-shield are thrown off by moulting, and replaced by a round head with short mandibles. Before the moulting process we have the head of a rapacious larva, afterwards one more adapted to the life of the average bee-larva. It is hardly necessary to state that the presence of such a larva in the cell of a leaf-cutter bee means certain death to the rightful owner.

TRIEPEOLUS HELIANTHI ROB., A PARASITE OF MELISSODES TRINODIS ROB.

Melissodes trinodis, a ground inhabiting bee digs down perpendicularly to a depth of about 8 cm., then turns off obliquely for a short distance, and continues in a perpendicular direction. The cells are somewhat thimble-shaped, their walls are formed of hardened clay with a very smooth and polished inner surface. They are filled about one-half with bee-bread.

The visit of the parasite ***Triepeolus helianthi*** to a nest of ***Melissodes trinodis*** on August 17, 1903 led me to open the nest on the day following. Two cells were exposed, one unfinished, the other closed, and showing the white, opaque egg of the host, 3mm. in length on the surface of the bee-bread. Nothing else was observed on this date. My further notes are as follows:

August 20, 8 P. M. The ***Melissodes***-egg seems to be near the point of hatching.

August 21, 6 A. M. The recently hatched host-larva is dead, and has evidently been killed by a parasite. Close to it on the bee-bread is the dead body of a parasitic larva with long curved mandibles (***Triepeolus helianthi***). Crawling lively around the smooth wall of the cell, above the bee-bread another larva of ***Triepeolus*** is observed, making biting movements. After a while this larva crawls down to the bee-bread, and bites the body of the dead parasite a few times in succession. Later on the sharp mandibles of a third parasite appear from below the surface of the bee-bread, also making biting movements.

8 A. M. Only one parasite alive, crawling around the wall. On the bee-bread the dead bodies of the two other parasites, as also of the host-larva. Any interference with the cell causes the parasite to open and close its mandibles several times. This larva has a number of flat lateral appendages (Fig. 7), organs of locomotion that

August 21, 6 A. M.	enable the insect to crawl around. The mandibles are, in size and appearance very similar to those of *Cœlioxys* (Fig. 5).
August 23.	The parasite is now spending most of its time on the bee-bread, feeding. It is not quite as agile as previously, but still making biting movements when disturbed. These are always performed in the same characteristic manner. At first the mandibles are pushed deep down into the bee-bread, closed and held quietly in this position for a few seconds. After this they are retracted so as to leave only their tips in contact with the bee-bread, and then opened and closed several times in rapid succession.
August 24.	The larva has moulted. The mandibles are small and the lateral appendages have nearly disappeared. In its present form the larva does not leave the bee-bread, and the biting movements are not as pronounced as formerly.
August 25.	Parasite dead.

A second nest of *Melissodes trinodis* dug out on August 25, 1903 furnished a cell with a larva of the parasite that had already moulted some time before. The lateral appendages were not in evidence in this larva, and it therefore seems probable that after the first moult has taken place, and the larva has begun a sedetary life on the bee-bread these appendages gradually disappear. (Fig. 8.) In the cell under consideration no remains of a host-larva could be discovered, but the dead bodies of two more parasites were found on the bee-bread. In this cell, as in the one from the first nest three parasitic larvae have been waging war on each other for the sole possession of the cell and its contents.

The parasitic larva of *Triepeolus helianthi* with its powerful mandibles and its head-shield resembles very closely the larvae of our two species of *Cœlioxys* referred to in this paper. But in *Triepeolus* we become acquainted with a new feature in the make-up of a bee-larva, viz., organs of locomotion that enable the owner to leave the bee-bread and crawl around on the interior of the cell. One of these parasites on the smooth wall may be in a more favorable position to attack than one below on the bee-bread.

CONCLUSION.

A consideration of the facts now in our possession from different sources leads to the following conclusions, regarding the larval habits of those bees that deposit their eggs in the nests of other bees.

In some cases we are probably not dealing with parasitism at all but with commensalism, where the larvæ of the host-bee and the intruder live quietly together, and reach their final development. Such seems to be the case with the species of *Nomada* in the nests of *Andrena* and *Halictus* as reported by Packard. The larvæ of *Stelis nasuta*, several of which according to Fabre live together in the same cell of *Cholicodoma* without attacking each other also seem to be commensals although we do not know whether they finally attack the host-larva or are indirectly the cause of its death by starvation. *Stelis minuta* observed by Verhoeff in the nest of *Osmia leucomelæna* and *Stelis sexmaculata* observed in our surroundings in the nest of *Alcidamea producta* are both decidedly parasitic, *Stelis sexmaculata* attacking with equally destructive results the host-larva as well as a larva of its own kind.

Parasitism among bees produces some very important changes in structure (hypermetamorphosis) and habits of the larvæ as demonstrated by the species of *Cœlioxys* and *Triepeolus* treated in this paper. The extraordinary development of the mandibles of these larvæ would seem to be quite out of proportion to their needs if the destruction of the harmless host-larva were the only thing to be accomplished. But when we remember the fact that these parasites are frequently present to the number of two or more in one cell, and have to fight with each other for the undisputed ownership of the cell, then the question suggests itself whether these weapons of attack, as also the peculiar organs of locomotion in the larva of *Triepeolus* have not been developed as a result of the struggle of these larvæ among themselves.

To my knowledge several writers have attempted to explain the origin of parasitism among bees. A more extended acquaintance with the larval life of guest-bees, as well as of host-bees from different regions of the globe might furnish a more solid foundation for a theory of this kind. The various degrees of tolerance exhibited by the larvæ of different species of host-bees might have to be considered in this respect, and for this reason I have laid especial stress on the pronounced tolerance of the larva of the host-bee *Ceratina dupla*, the lesser degree of tolerance of the larva of the host-bee *Alcidamea producta*, and the aggressive tendency of the larva of the parasitic bee *Stelis sexmaculata*.

Fig. 1. Diagrammatic longitudinal section through a cell in the nest of *Alcidamea producta* Cress.
a. Egg of *Alcidamea*. b. Egg of parasite *Stelis*.
Fig. 2. Mandible larva of *Alcidamea producta* Cress.
Fig. 3. Mandible of larva of parasite *Stelis sexmaculata* Ashm.
Fig. 4. Diagrammatic longitudinal section through lower half of a cell of *Megachile latimanus* Say.
a. Egg of *Megachile*. b. Egg of parasite *Cœlioxys*.
Fig. 5. Head of larva of parasite *Cœlioxys rufitarsis* Sm., before 1st moult.
Fig. 7. Larva of parasite *Triepeolus helianthi* Rob., before
Fig. 7. Larva of parasite *Triepeolus helianthi, Rob.*, before 1st moult.
Fig. 8. The same several days after 1st moult.

CANVAS-BACK DUCK FOOD.

H. L. SKAVLEM.**

**Abstract of a paper read at the April meeting of the Wisconsin Natural History Society (1904) and published in full in The Northwestern Sportsman, 1905, pp. 161-164, 236-240.

Ornithologists have been accustomed for many years to copy Wilson's description of food habits of the canvas-back duck with reference to its fondness for "wild-celery," *Vallisneria spiralis*, and the good effect of the same on the flavor of the flesh. The writer shot canvas-back duck on Lake Koshkonong for a quarter of a century, believing that the *Vallisneria* was the bait which attracted the birds to the lake, but in locating the celery beds found that the duck usually chose other spots where no celery was to be found, although examination of their stomach always revealed "buds" having a strong taste of celery presumably derived from the *Vallisneria*. Very often they would settle on the great submerged meadows of pondweed (*Naidaceae*) locally called moss or sedge.

During the season of 1895 the writer discovered in examining masses of this floating pondweed that the so-called "celery-buds" were none other than the terminal buds of this plant. This explained their indifference to the *Vallisneria* and fondness for localities where the pond-weed (*Potamogeton pectinatus*) was abundant since the latter forms the real food of the ducks.

An examination of the literature on the subject reveals a surprising number of incorrect assumptions and erroneous statements on the part of various authors, regarding the food of the canvas-back. Wilson states that the ducks feed on a plant "said to be a species of *Vallisneria*" growing on fresh water shoals, and that they dive to tear out and obtain the roots which have the appearance of small celery. It appears that Wilson had in mind the common "eel-grass" (*Zostera marina*) and not *Vallisneria* at all. Nuttall (Amer. Ornith., III p. 29) corrects Wilson's error and states that the birds feed on the tender parts of the root of the "sea-wrack." Audubon in his great work overlooks Nuttall's correction and repeats Wilson's remarks on *Vallisneria*. Chapman (Hand-book of Birds of Eastern N. Amer., 6th Edit. (1903), p. 111) describes the favorable effect of wild celery on the flavor of the canvas-back. If for "wild celery" we substitute *Naidaceae* (which includes *Zostera* (eel-grass), *Ruppia* (ditch-grass) and the species of *Potamogeton* (pond-weed), *Zizania* (wild-rice), *Hydrocardiaceae* (to which *Vallisneria* belongs) we have the proper list of food plants. At Lake Koshkonong it was found that "celery-buds" (*Potamogeton pectinatus*) formed from 60% to 80% of the ducks' food.

OECOLOGICAL FEATURES OF EVOLUTION.

BY E. C. CASE.

The attention that has been called to the principle of adaptive radiation by the recent papers of Prof. Osborn and his followers in the American Naturalist has led to the suggestion that some good might be derived from viewing the subject from a slightly different standpoint. Osborn has concerned himself with a demonstration of the fact that in successive periods the various phyla have developed in a diffuse way producing a large number of forms peculiarly adapted to the local conditions and that this process has been repeated with close similarity in each period. Other writers have concerned themselves with the way in which the adaptations have been produced; all writers have looked at the subject from the standpoint of the animal. It seems worth while to look at the subject from the standpoint of the environment; to analyze the environment in order to detect its possibilities in influencing the change in the animal form.

For the purposes of the discussion it is recognized that adaptation is as much a fact as heredity and its processes as much of a mystery. With the *processes* the dicussion has nothing to do nor even whether the environment induces the adaptations; it is assumed that the environment changes and that the *adaptation follows the environment.*

Most of the points gone over have been discussed before and are even the classics of the literature of evolution but so far as I know no one has attempted to place the environment in the foreground of the discussion. This our increasing knowledge of the principles of physiography and of the climate and surface of geological areas will enable us to do with increasing value.

New names do not explain old problems and the few introduced here are only used for the purposes of clarity.

For simplicity in approaching the subject let us take a concrete example. An animal (the principles seem equally applicable to plants but the author's limitations compel him to turn to animals for illustrations) of generalized structure and potential variability enters by migration a new region; the overwhelming chances are that it will encounter one of two conditions, either the *sum of its contacts* with its new environment (using the term environment in its widest sense, food, competion, enemies, climate, surface, breeding places, etc.,) will be hostile to the new form, ***environmental hostility*** (lack of adaptation in the animal), or the sum of its contacts with the environmental will be favorable, ***environmental hospitality*** (adaptation in the animal). The third possibility, that the animal will find the sum of its contacts so exactly balanced between the two that their effects will be neutralized is so remote that its occurence can only be considered as an interesting possibility. There will of course be all grades of hospitality and of hostility from the superlative to the least possible that will result in the triumph or extinction of the animal.

Should the animal encounter environmental hostility its habits or structure or both must become altered (adapted) or the form will perish, and its variants will be more liable to persist than the parent. Should it encounter environmental hospitality it would survive and variations would be more liable to extinction than to preservation (see below).

The environment of any life form is not necessarily the sum of all the factors that we can appreciate. There may be many things of which we have no consciousness which bear importantly on the form; or things which we can appreciate only by an effort, or things which we appreciate but to which we attach no value. To take one of the least complex instances, we appreciate the color of a flower only through an artifically cultivated aesthetic sense but that color is often the determinant factor in the environment of the flower or the insect which visits it. The possible number of differing sums of contacts is so enormous that it is possible and probable that no two groups of animals have exactly the same.

The fact that forms in a condition of seeming environmental hospitality do develop new forms is explainable on the supposition that there are unperceived factors in the environment or that of those perceived we have given an undue importance to one or more and the sum of contacts may have a reversed sign from our determined answer. The very fact of environmental hospitality must in time produce an opposite condition.

The condition of environmental hostility may result from two sources.

I. From contact with other animals. This may be again subdivided into two parts. ***Active hostility*** and ***passive hostility***. Active hostility of the environment would mean the attacks upon the life of the animal by predatory forms; perhaps also the attacks of parasites and even bacterial invasions. So far as the animal is preyed upon by other animals it forms an element of hospitality in the environment of the predatory form and conversely if it finds forms in the new region which it preys upon they become elements of hospitality in its environment. So complex are the relations that the introduction of an element of hostility to one form may result in an increase of hospitality to another as when a predatory form abandons the refuse of its meal to the carrion feeders. Darwins classic example of the relation between the number of cats and the clover crop of a neighborhood is a case in point.

Passive hostility of the environment from animals is almost if not quite the same as the hostility of inanimate things. The competition for food, breeding places, etc., among different forms and among individuals of the same species; it involves the struggle for existence among life forms.

II. From contacts other than animal. Under this head must be grouped a large series of contacts which can only be suggested within the limits of this article. *Climate*, this may be favorable or unfavorable to the new form in its tendency to drought, humidity, great range of temperature or stability of temperature. *Surface*, the rough or broken surface, hills, plains, plateaus or swamps; each would afford peculiar possibilities for or against food, protection, breeding places, etc. *Rocks and soils*, affording facilities of burrowing, etc. *Hydrographic features* as rivers, lakes, each carrying its aid or opposition to the new comer. The list might be extended almost indefinitely but would have to be varied for each form and almost for each individual.

Should the animal encounter conditions of hostility in its new environment its only chance for survival would be the development of new structures or habits that would enable it to use more or fewer than the original contacts or be able to use or resist the originally hostile contacts in such a way as to alter their effect from hostility to hospitality.

At this point another element must be considered, that of *time*. This element is worthy of rather more consideration than it has already received. The assumption of unlimited time is one that paleontology has inherited from its foster-mother geology and the assumption has also tinged the writings on recent zoology. The form in an hostile environment has but two goals before it, adaptation or extinction. That the latter has been commonly attained we have ample evidence. The change in the environment which renders it hostile to the animal may be sudden or very slow. In the former case the animal has small chance for survival. Such a case would be the introduction by migration of a predatory form as the introduction of the hunter with his gun, into regions previously unvisited. The burning of forests and prairies; volcanic eruptions, etc., would have only a very local effect, upon species of limited distribution, upon varieties or races and even on individuals. But the clearing off of the established forms may open the way for the introduction of migrant forms; this is especially well illustrated in the occupaton of burnt over lands by the new forms of plant life. In every case swift extinction will follow if the animal does not produce changed form or habit fitted to the changed environment. If the necessary change is one involving habit the possibilities of the animal responding in time to avoid extinction are greatly increased but this depends in a large measure on the potential variability of the animal; the seals return year after year to the same breeding place and to almost certain extinction. The English Sparrow on the other hand has developed familiar habits and breeds on the structures that man has erected in place of the destroyed forest. The chimney swallow has accepted the chimney in place of the hollow tree and the work of man has become an element of hospitality in their environment. The birds mentioned have developed habits in time to profit by the changed environment, it is doubtful if the seal will do so.

Adaptations in structure or function would require a much longer time and could not possibly win out against any sudden change but might do so through the long time involved in changes due to geological development of changed land surfaces and climates. This last statement must not be interpreted to mean that a suddenly developed new form as one of DeVries primroses or any sport that becomes established would necessarily encounter environmental hostility at the beginning; for the new structure, function or habit might, in the rare instances when such a form is established, present a peculiar combination of characters that will enable it to seize upon a hitherto unoccupied group of contacts and so experience environmental hospitality from the start, although the parent stem from which it developed was also in the same state; much the larger number of the variations however, would experience a hostility so great as to cause extinction.

Such is the course of ordinary morphological development following the changes of the environment and the plentiful instances of extinction are ample evidence that the failure of animal forms to produce their change in time has been no inconsiderable factor. It is not presumed that given sufficient time any form could produce any required change, for we know that many forms in profiting by unoccupied groups of contacts have developed a specialization from which they could never retreat, for so narrow is the line between hospitality and hostility that any change in their environment will render it violently hostile, even to extinction.

Changes in the environment that would produce a hostility of the second type described above (climate, surface, etc.) would be less liable to produce extinction and more liable to result in the survival of slightly changed forms than changes of the first type (other animals). As will be shown below slow changes are ample to account for the process described as mutation by Scott and "definite variation" by Osborn.

Environmental hospitality as defined above is the condition when the sum of any animals contacts with its environment is favorable. It may be discussed under the same two heads as environmental hostility. 1. Contacts with other animals. 2. Other contacts.

The first of these may be reduced to nil. By *environmental isolation* would be expressed the fact that the new form would not come into contact, either actively or passively, with other animals. It is obvious that this condition might occur in regions that were crowded with other animals if the habits or structure of the form permitted it to seize on a group of contacts that were not occupied by some other form, and if it was not an acceptable prey to other animals. This conception is a most useful one as it explains the possibility of the introduction of new forms and their development, even luxuriant development, in regions that are seemingly already crowded.

Environmental isolation may be found immediately by an animal entering a new region or it may be achieved after a period of hostility; after a period of successful competition with other forms in passive hostility, or after a period of active hostility when the predatory form has become for some reason reduced, or by the development of new habits or structures which would render it independent of the other forms. (Environmental isolation might exist in envronmental hostility but it would be rare as it is such a powerful factor on the positive side of environmental hospitality).

There is no thinkable isolation from contacts other than animal.

Environmental hospitality once attained the perpetuation and increase of the animal would be assured. But the very increase of the animal due to the hospitality would introduce a feature of hostility. The often calculated results of the unchecked increase of even the slowest breeding animals show how quickly the possibilities of the hospitable environment would be taxed and the very number of individuals would introduce the factor of passive hostility among animals of the same species. Moreover the increase in numbers would afford the most hospitable field for the development of predatory habits, or the concentrated attacks of hostile factors, as wolves follow herds of deer or buffalo, or diseases attack communities of plants or animals.

Environmental hospitality presents two other phases. 1. *Environmental diversity.* 2. *Environmental monotony.* In the first the sum of favorable contacts includes a great variety of factors as variable climate, diversified surface, complex food supply, etc. The second would be the reverse of this, a simple climate with monotonous surface and simple food supply, such a condition would obtain in the deeper ocean or lake waters, the surface of an ocean or lake far from the shores or the surface of a large plain, plateau or desert.

It is readily seen that a region might be diverse to one form and monotonous to another as a plain might have a variable climate which would be of importance to one form and indifferent to another while the other factors were in common. The two conditions, environmental diversity and monotony would result very differently. In the first the diversity would render it more probable that varieites would find a favorable sum of contacts and so become permanent as species while it would at the same time indefinitely postpone the approach of passive hostility among the individuals for the varieties though more liable to extinction than in a condition of environmental hostility would be less liable than in a condition of environmental monotony.

On the other hand animals developing in a condition of environmental monotony would soon arrive at a condition of overcrowding and passive hostility among the individuals, for the poverty of the environment would place the varieties even in their inception in a condition of hostility while those which bred true to the parent would experience hospitality and survive; the result would be large numbers of individuals of the same species. A good example of this is where animals essentially terrestrial have passed over to an aquatic habit, as the marine reptiles; they are limited in the number of genera and species far beyond the land reptiles. As the varieties would constantly fail and the individuals increase passive hostility would soon supervene and the number of individuals would reach a limit. As it is evident that although the passive hostility might encourage the development of forms the environmental monotony would limit the number; it is possible that we have here the explanation of the survival of archaic forms such as the genus Lingula among brachiopods and the Sphenodon among reptiles.

In an absolutely monotonous environment there would be no possibility of the survival of a variety.

In environmental diversity the hospitality of the region would permit the persistance of a large number of varieties this might be carried to such a degree that the hospitality of the region for a variety might be determined by one minute feature i. e. the animal would be highly specialized or minutely adapted. As the dependence of the Yucca plant on a single species of moth for its fertilization.

Placing the environment of a developing form in the foreground allows of a reinterpretation of several factors of evolution long in use. Such as the Mutation of Scott, the Definite Evolution of Osborn and his Homoplasy; the Vital Principle of various authors. All of these assume that to some extent at least the animals pursue their development independent of the environment, in spite of the environment; that they successfully resist permanent environmental hostility. Williams recognized this in his Biological Geology, p. 35, where he says "When, however, we are led to ask how the adjustments came about in geological time, we have to choose an answer from these two possibilities, viz., either (a) slowly progressing and relatively constant evolution has taken place among organisms constantly struggling together and varying or (b) faunas become rapidly adjusted to new conditions, attaining a biological equilibrium, and then maintain that equilibrium with extremely slight variation for great periods of time, under like conditions, but quickly and rapidly suffer specific modification whenever the environment changes, and the equilibrium is thus disturbed."

Elsewhere in his book he assumes that faunas shift geographically but says that it is "natural to suppose" that new species would develop in the process. This would only be possible if the environment changed in character as well as geographically. That is if a shoreline retreated by elevation of the sea bottom and new species developed in the process it is fair, even imperative, to assume that the shore line has changed somewhat in the character of the bottom, water, temperature, etc.

Mutations or definite evolution can only, from the very nature of the case, appear in the higher taxonomic groups as genus, family, order, etc., and an examination of their characters shows that this is rather more apparent than real. A genus, family, or order is only a group of characters, whose definite variants form the next lower class. As a genus is only a group of characters it can have no definite life, no individuality, and there can be no determinate influence working upon it; it can only exist in the fact that a group of variants, species, unite in having common characters. The species is the nearest possible approach to taxonomic unity, as it is by conception the group having the largest number of common characters; to carry the division one step farther into the individual would result in a wholly natural classification i. e. chaos in our artificial systems. As the species is only a group of individuals profiting by adjustment to a hospitable sum of contacts it follows that the genus exists only in the fact that certain elements in this sum of contacts are common to the group of species. So long as the environment retains a fundamental group of contacts, so long will the species having common characters i. e. the genus, persist. The mutation of a genus is the slow accommodation of a group of species to a fundamental change in the environment while around this play a large number of specific changes due to the less important but more obvious changes in the environment.

Mutations are not in defiance of the environment but a close response to its fundamental most slowly changing elements. Williams in his distinction between mutation and variation does not use this point of view. He says. Bull. U. S. G. S. p. 210, variations are "differences expressed by specimens of the same species —differences arising coincidentally with extension of geographical distribution and changes in condition of the environment." Mutations are "changes of form that are coincident with passage of time, and hence to generational succession *under conditions of life so nearly the same* that extinction of the race does not result." This is the idea of Scott's Mutations and Osborn's Definite Evolution; the idea here proposed is that mutation is as much a response to the changing environment as variation but that it is the visible concurrence of different species in a common line of change determined by the fundamental features of the environment and their change.

It is interesting just at this point to examine somewhat the work of DeVries and Burbank in the light of a possible explanation, on this line. DeVries work was, as all know, done on a species of Primrose, some times referred to as the Asses Weed, or Onagrathe (*Oenothera lamarckiana*). This weed was introduced into Europe from Virginia in 1613. Introduced into Holland it soon became acclimated and is cultivated there; it also grows there in a wild and uncultivated state having escaped from gardens. One species the lamarckiana is especially abundant about the city of Hilversum. In 1875 it was noticed that in this district this species showed unusual vigor and remarkable powers of dispersal and multiplied in profusion.

Here is evidently, a case where a species has found a chance to grow to large numbers in a new environment, it has evidently found hospitality; but that the hospitality attained is not absolute is shown by the fact that the species was in a violent state of change, variants being produced in large numbers and indiscriminately for DeVries notes that many of the varieties are evidently less well fitted to survive than the parent. His idea is that the mutation is a period of the species life and independent of environment but its history shows that it is essentially a migrant form in a new environment. He says "ordinarily the principal period of mutation is found at the earliest stage of the species, at the time of its birth, but this is not absolute. However, the phase, or the entire group of phases, of plasticity, is more or less brief in comparison with the rest of its existence." This idea Burbank denies in that he says it is not a period of the species existence but a condition of the species which he claims to be able to produce at will. As quoted by Harwood in the April Century, 1905, Burbank says: "The life forces are constantly pressing forward to obtain any space which can be occupied, and, if they find an open avenue, always make use of it as far as heredity permits." His idea of DeVries mutation is the disturbance of the life processes of a plant by crossing and the resultant confusion of hereditary processes, the inertia of the influence of each parent in the offspring in an automatic attempt to produce characters which were proper for its own environment resulting in abundant sporting.

Both have evidently recognized the disturbed condition of the environment which Burbank has produced and DeVries discovered; the environment of both is changed or changing and the species and individual are responding in the abundant variants.

The most prominent objection to the explanation by this means is that a species in a changed environment does not always produce heterogeneous variants but that they some times vary toward a definite type, new or atavistic.

Under the term Vital Principle has been expressed the idea that a species, genus, family, etc., has a definite span of life comparable to that of an individual; that it has its inception, period of growth, period of decay and death and that this is determined by some force inherent in the group itself. If the fact is kept in mind that the genus and higher are but groups of concurrent characters and have no individual life this idea loses much of its force. If we consider the lowest group, the species, where the idea would have its strongest support it can be shown to be at least gratuitous. The birth of a species is the growth to recognizable quantity of the number of individuals responding to a certain definite group of contacts; having attained environmental hospitality the species increases in number until it reaches the limit of hospitality in the environment and is checked by the concomitant hostile contacts. As the hospitality reaches its limit and hostility intervenes some certain variables will become important as they have the ability to use the same environment as the parent, plus or minus one; but this ability to use the sligthly variant environment determines its success and it becomes an important and fatal element of hostility to the parent as it responds so nearly to the same group of contacts as the parent which must wane as the variable grows. Of course a slight change in the environment might produce the same effect before the animal had matured its own hostility.

The theory of *continuously improved structure* is deceptive in statement, the idea is strictly anthropomorphic. There is no theory of *continuously better adaptation* for the conditions toward which adaptations tend are continuously changing and the variation is as liable to reverse the previous direction of change as to continue it. If anything, it should be called the theory of more and more perfect differentiation; the response to the smaller and smaller elements in the sum of contacts.

The idea of improvement in the fancied approach to the mammalian and human type may therefore be dismissed. The true statement is that in time forms have become increasingly complex. This increase in complexity is due to the response to increasingly small (in quantity) differences in the sum of contacts of related species or varieties; for instance, the general difference between two groups may be as the difference between 4 and 5 but between two species of one group it may be as the difference between 4.9764 and 4.9765. A difference in the 10000 place may mean a quantitative difference so great as determine the hostility or the hospitality of the environment. A reindeer has four legs but it is almost entirely dependent on reindeer moss for food.

The first is in common with the vertebrates but the last distinguishes it from its nearest ally. The variations permitting the use of new groups of contact thus departs farther and farther from the original structure and the environment appropriate to it. Parasitism and degeneration are just as definitely a following of this law as the attainment of a highly complex structure.

The result may be a peripheral development with strengthening of the new and gradual loss of the old, as a plant which propagates by suckers may be strong at the outer ends but the parent center dead. The classic case of the embryonic gill slits in the mammals illustrates well the final rudimentation of a once fundamental feature while the importance of the mammary glands is an equally good example of the strengthening of the new.

The appearance of fishes, amphibians, reptiles, birds and mammals in order in geological time is no argument for continuous improvement, their inception and flower mark the conquering of a new group of contacts so that almost every variety produced found a hospitable sum of contacts awaiting it. So long as the fishes produced varieties fitted only to breathe in water so long was the possible hospitality of the contacts limited but when a variety was produced which could also breathe the air the possible group of contacts was increased so enormously that almost every variable found a group of contacts hospitable to itself. This statement is not in conflict with the previous one that environmental hospitality would have a tendency to keep down the establishment of new forms; that would be true where the possibilities of the environment were small but when a whole new realm is conquered, as the air in the case of the first air-breathers, the statement must be reversed until the new region is well filled.

As to the series fish, amphibian, reptile, bird and mammal indicating improvement it would hardly have been suggested had our brains developed in the body of a fish or a parasitic worm, even as now we fail to appreciate the delicate adjustments or the organism of the serpent or the lizard.

An interesting application of the theory arises in the development of the early vertebrates. The first of the air breathers quickly became entirely terrestrial in habit and only later returned to the sea under stress of environmental hostility on the land. Geology teaches that the Carboniferous age, in which the air-breathers first appeared in any prominence, was a time of great transgression of the sea, or great humidity and luxuriance of vegetation; but at the end of the Carboniferous the sea retired and there insued a period of dessication as shown by the salt and gypsum beds, the prevailing red color of the rocks and the lack of wide spread marine deposits. Applying at this point Chamberlins theory that the exposure of land masses with their consequent degradation meant the extraction of large quantities of CO_2 from the air and a subsequent period of refrigeration if not glaciation it will be seen that the advent of the reptiles in the late Carboniferous and the Permian was coincident with the appearance of large land masses and a decided climatic change from that in which the amphibians flourished; almost as great as the change from the habitat of the fish to that of the amphibian. The amphibians had carried their specialization very far in the watery environment but the elevation of the land and its dessication produced a series of new possible contacts which permitted the variables of the amphibians to establish themselves as land reptiles. Then began the wonderful growth of the reptiles in Triassic and Jurassic time which soon so crowded the land that by the middle Trias, the Muschelkalk, when the waters gained a slight ascendency over the earth for a time the variables of the land reptiles returned under new forms to the waters which became crowded with the Nothosaurs, Plesiosaurs and even Ichthyosaurs. With the wide spread Jurassic seas the Ichthyosaurs were abundant and so the Mosasaurs of the Cretaceous seas but just as today, the environmental monotony of the oceanic environment for air-breathing animals kept down the number of variables which established themselves, i. e. the species, though the individuals multiplied beyond number.

THE NUMBER OF YOUNG OF THE RED BAT.

HENRY L. WARD.

At the March meeting I presented before the Society a mounted specimen of the Red Bat, ***Lasiurus borealis***, with four young, calling attention to a previous record, by M. W. Lyon, Jr., in Proc. U. S. Nat. Mus. Vol. 26 pp. 425-426, of this number of young for this species, the article also containing an account of the numbers previously recorded i. e. two having two young and two having three young.

In "Science" N. S. Vol. XXII No. 549 (July 7, 1905) pp. 20-21, I gave a resume of the observations then made, including four by myself, and requesting records from others.

Prof. John L. Sheldon of the Agricultural Experiment Station, Morgantown, W. Va., writes me that when teaching in the Nebraska State Normal School in 1900 some boys brought him a red bat, "as I called it, in distinction from the much darker brown ones, with three young attached to her. The young were about half grown."

Mr. Clyde Fisher, assistant in Biology and Geology in Miami University, Oxford, Ohio, writes me under date of July 17th: "A few days ago I found several red bats (*Lasiurus borealis*) hanging head downwards, by their hind claws, in trees between the gutter and the sidewalks along the streets of our town. I succeeded in capturing a female with *three* young clinging to her."

Recently in overhauling some alcoholic specimens in the basement of the museum an unrecorded preparation of a female Red Bat with four young was found, the label stating that they were taken "early in July, 1899. Donated by H. A. Kirchner."

As the data stood in my notice in "Science," the recorded numbers of cases with their respective number of young was 2x1, 2x2, 3x3 and 2x4. Adding the above mentioned cases to these we have the revised count 2x1, 2x2, 5x3 and 3x4. While these twelve records are far short of what are required for satisfactory generalization they yet have altered the facies of the former tabulation and we now find that four young are more common than is a number smaller than three, of which latter number the table shows a greater preponderance than before.

In "Science" I adverted to the possibility of a bat losing one or more of her young by death or by their accidentally becoming detached. However, as the two instances of two young and two of those having three young were founded on embryological evidence we must find that this species may give birth to as small a number as two offspring.

The average number of young of this as well as of other species of *Lasiurus*, which, with *Dasypterus*, as pointed out by Mr. Lyon, are distinguished from other bats by the possession of four mammæ and the birth of more than the usual one or two young, is still a matter of doubt.

NOTES AND DESCRIPTIONS OF NORTH AMERICAN PARASITIC HYMENOPTERA.

CHARLES T. BRUES.

BETHYLIDÆ.

CHELOGYNUS Haliday.

The six species at present known from North America may be recognized as follows. In addition to these it is probable that several Mexican forms described by Cameron (Biol. Cent. Am. Hymenoptera, p. 444 *et seq.*) under the genus *Dryinus* belong here.

Females.

1. Body entirely black....................................4
Body wholly or partly ferruginous.......................2
2. Entirely ferruginous, mandibles 4-dentate...........
.................................*ferrugineus* sp. nov.
In part black..3
3. Head and abdomen black, thorax reddish, mandibles
4-dentate..............................*atriceps* Brues
Ferruginous, abdomen alone black........*atriventris* Cress.
4. Legs pale rufous.....................................5
Femora black, except apical part of anterior pair;
mandibles 4-dentate....................*grandis* sp. nov.
5. Clypeus pale or rufous, mandibles 5-dentate.*henshawi* Ashm.
Clyeus black, mandibles 3-dentate........*canadensis* Ashm.

CHELOGYNUS FERRUGINEUS sp. nov.

Female. Length 5 mm. Entirely ferruginous, except for the darker tips of the antennæ and tarsi. Head large, the vertex gently convex, rugoso-punctate, the front below the ocelli longitudinally striate-reticulate. Occiput and cheeks shining, sparsely punctate, margined as are also the eyes. Antennæ ten jointed, the scape slightly shorter than the first flagellar joint, which is two times the length of the pedicel; following joints about equal, two-thirds as long as the first; scape whitish at base below and apical five joints infuscated. Mandibles yellow, with four black teeth. Prothorax shining, finely punctured and covered with short griseous pubescence, a little longer than the mesonotum; the latter polished, with a few punctures and two distinct furrows.

Scutellum and post-scutellum convex, shining, the latter with an oval fovea on each side, the foveæ vertically striated. Metathorax short, abruptly declivous behind, finely reticulated. Abdomen short, oval, stout, polished and impunctured. Legs ferruginous, the anterior femora thickened as usual; first tarsal joint not longer than the following three united; chelæ small. Wings hyaline, with two fuscous bands; the first indistinct, crossing at the tips of the basal cells; second broad, beginning at the stigma and fading out apically and posteriorly. Both basal cells distinct. Stigma pale, oval, marginal cell incomplete.

One specimen labelled Texas. Type in the collection of the American Entomological Society.

This species is readily recognizable by its reddish color. The broad abdomen gives it a very wasp-like appearance, its general habitus simulating that of a small pompilid.

CHELOGYNUS ATRICEPS Brues.

Bocchus atriceps, Brues, Can. Ent. XXXVI, 118.

On re-examination of the type of this species together with a second specimen recently acquired from Wisconsin, I find that the maxillary palpi are five jointed so that the species falls more properly in this genus.

CHELOGYNUS GRANDIS sp. nov.

Female. Length 7 mm. Black, legs in part yellow. Head moderately large, the vertex gently convex, finely rugose; the front below the ocelli with three median raised lines beside the lateral margins around the eyes; sides of face below rufous. Antennæ rufous, the apical five joints blackened; scape scarcely two-thirds the length of the first flagellar joint which is three times the length of the pedicel; second flagellar joint distinctly longer than the third. Mandibles 4-dentate, black, except for a pale band just before the teeth. Palpi fuscous, five jointed. Occiput and cheeks shining, finely punctured and sparsely clothed with white hairs. Prothorax strongly contracted, about equal in length to the mesonotum, marked with a reddish spot at the base of the fore coxæ; pronotum closely punctured. Mesonotum polished, delicately punctulate. Parapsidal furrows very well marked, tegulæ rufous. Scutellum shining, convex. Metanotum short, convex, finely rugulose. Abdomen polished black, narrow and elongate, as long as the thorax. Legs black, except the four anterior tibiæ and tarsi, the base of the anterior trochanters and the tip of the anterior femora. Wings hyaline, with two fuscous bands, the first narrow, just beyond the basal cells, second broad, beginning at the middle of the stigma. Stigma oval, black, pale at base; two basal cells present, radial nervure incomplete although the marginal cell is closed by a delicate indistinct nervure. A discoidal cell is also indicated by very delicate nervures.

One female from Riverside, Mass., collected by Mr. C. W. Johnson and transmitted to me by Mr. H. L. Viereck.

This species resembles ***henshawi*** Ashm., but is distinct by the darker color of the legs; ***henshawi*** also lacks the raised frontal lines.

CHELOGYNUS HENSHAWI Ashm.

Bull. U. S. National Museum, No. 45, p. 93.

The color of the clypeus varies considerably in this species. One specimen which I have seen has the latter and the sides of the face below light yellow.

ANTEON Jurine.

ANTEON ANNULICORNIS n. sp.

Female. Length 3 mm. Black, the front legs and antennæ in part yellow, wings bifasciate. Head opaque black, finely scabrous; front with a central and two lateral raised lines; eyes, occiput and cheeks margined, the latter finely punctulate. Mandibles 4-dentate, rufous at base; clypeus punctate. Antennæ piceous, the scape and flagellar joints 3-5 reddish yellow. Scape slightly longer than the pedicel and first flagellar joint together, the latter one-half longer than the pedicel; second flagellar joint equal to pedicel, following joints becoming longer and stouter to the last which is two-thirds the length of the scape. Pronotum shining, about one-half as long as the mesonotum, the latter shagreened and with a few large punctures anteriorly. Parapsidal furrows not indicated. Scutellum short, convex, with a punctate frenum anteriorly and with a few rather stiff black hairs on its disc. Metathorax reticulated, with a transverse carina where it bends down and a few indistinct striations apically. Abdomen short, shining black, the extreme tip rufous. Legs black, except the tips of the anterior femora, anterior tibiæ and tarsi and tips of four posterior tarsi, which are yellow. Chelæ rather small, the first joint of the anterior tarsi no longer than the three following, fourth joint but little longer than the third. Wings hyaline, with a distinct narrow band at the tips of the basal cells and a second wider sharply defined one beginning at the base of the stigma and reaching two-thirds of the way to the wing tip; neither band reaches the posterior margin of the wing. Stigma black; the stigmal vein as long as the stigma, knobbed at the tip.

Described from a female specimen from Mexico, collected by Mr. E. A. Schwartz. Type in the collection of the American Entomological Society.

This species comes near to Cameron's ***Dryinus albitarsis*** (Biol. Cent. Am. Hym. 447.) but is distinct by its annulate antennæ and different sculpture.

COSILIDÆ.

SIEROLOMORPHA Ashm.

This peculiar Cosilid genus is represented by but a single species which occurs in the United States, previously known only in the male sex.

In a lot of Bethylids recently received from Mr. H. L. Viereck there are a large number of males and two female specimens.

The female differs from the male by its more strongly thickened femora and stout tibiæ, and by the incrassated antennæ which are only 12 jointed (13 jointed in the male). The head and thorax are more shining, being very highly polished. The legs, except coxæ, are ferruginous.

The single species, *S. ambigua* Ashm. (Bull U. S. N. M. 45, 56) is widely distributed. I have seen specimens from New Hampshire, Connecticut, Massachusetts, Georgia, and Vancouver.

PROCTOTRYPIDÆ.

DISOGMUS OBSOLETUS sp. nov.

Female. Length 2.5 mm. Black, more or less brownish, shining; legs brownish yellow. Head transverse, about two and one-half times as wide as long antero-posteriorly; smooth and polished above, front prolonged below forming a strong carina between the antennæ; eyes large and convex, sparsely hairy. Lower part of face roughly sculptured, brownish; mandibles rufous, palpi pale yellow. Antennæ slightly longer than the head and thorax, brownish yellow, darker apically and at the incisures. Scape sub-globose, pedicel very small, only about one-third the length of the first flagellar joint; second flagellar joint two-thirds the length of the first, about twice as long as wide; following joints subequal to second, except last which is nearly twice the length of the penultimate. Mesonotum with indications of parapsidal furrows near its anterior margin, elsewhere shining and convex, impunctured. Scutellum as usual, with a deep groove at its base. Tegulæ yellow. Metathorax brownish yellow, with a median carina which extends almost to the base of the petiole and a lateral carina on each side, the three connected across the top of the posterior face by a transverse carina; elsewhere coarsely reticulate. Abdomen as long as the head and thorax together, cauda one-third as long as the abdomen. Petiole brown, about as wide as long, rugosely sculptured. Abdomen piceous brown lighter basally and yellow; cauda yellow at base, black at tip. Legs brownish yellow, tips of tarsi blackish; posterior tibial spurs weak. Wings brownish hyaline; the stigma long, with parallel sides, pointed at tip, four times as long as wide. Stigmal vein short, marginal cell a little longer than the stigma, triangular. Discoidal veins very faintly indicated by fuscous streaks.

One female, Morris Cove, Conn., May 20, 1904, received from H. L. Viereck.

The present species differs from the more typical forms of *Disogmus* in having only slight indications of mesonotal furrows. The venation agrees much more closely with this genus than with *Proctotrypes* however, and I am led to place it here.

DIAPRIIDÆ.

GALESUS VIERECKII sp. nov.

Male. Length 3.5 mm. Black, the first three antennal joints brown, legs, except coxæ, rufous yellow. Head shining, impunctured, sparsely clothed with long pale hairs; convex above, flat beneath; front projecting just in front of the anterior ocellus, the margin of the projection toothed laterally and sinuate medially; prominence below antennæ rounded-truncate, deeply emarginate medially. Antennæ 14 jointed, reaching to the middle of the abdomen; scape, pedicel and first flagellar joint rufous, remainder piceous black; scape thickened, angulated beyond the middle; pedicel and first flagellar joint both very small, together shorter than the second flagellar joint, the pedicel stoutest; second and following flagellar joints about equal, decreasing in thickness, last a little longer and pointed. Mouthparts rostriform, black; tips of palpi testaceous. Collar thickly white hairy.

Mesonotum shining, impunctate, with two deep furrows. Scutellum with two large oblique, oval basal foveæ; grooved laterally behind, its posterior margin crenate, straight; postscutellum with a median and lateral carinae. Metathorax with an A-shaped series of carinæ, the upper triangular portion very small, its surface rugose, shining, the posterior angles produced. Abdomen clavate, polished; petiole coarsely fluted, pale hairy; second segment at base with three short, deep sulci, very long, the remaining segments barely projecting beyond it. Genitalia projecting as three rufous prongs. Legs ferruginous, the coxæ black. Wings entire, not emarginate at apex; submarginal vein terminating some distance from the costal margin in an oval, brownish, stigma-like spot; basal veins pale brown.

One male from Colebrook, Conn., July 21, 1905.

Named in honor of my friend Mr. H. L. Viereck, to whose kindness I owe many interesting species of Proctotrypids.

LOXOTROPA MODESTA sp. nov.

Female. Length 1.5 mm. Black, with legs and antennæ, including the club, reddish. Head shining black, not angulated above the eyes. Antennæ rufous, the scape as long as the club, but shorter than the funicle. Pedicel about one-third as long as the scape and slightly longer than the first and second flagellar joints together; second to fifth flagellar joints about equal, shorter than the first and narrower than the sixth and seventh. Club of the usual shape, brown; its joints of equal length, the second quadrate. Posterior surface of head delicately transversely aciculated. Thorax shining black, the tegulæ and metathorax rufous. Scutellar fovea not extending across the entire base, rather deep; the lateral grooves wanting. Upper surface of metathorax slightly darkened, without any central carina, its posterior margin strongly emarginated, the lateral angles continued into prominent teeth. Petiole of abdomen rufous; wooly. Second segment very long, polished. Wings pubescent, very faintly tinged with brownish.

Described from a single female collected at Lehigh Gap, Pa., July 13, 1900 and transmitted to me by Mr. Henry L. Viereck.

The present species is related most closely to *L. abrupta* Thoms. and *L. californica* Ashm., but differs from both in the form and color of the antennæ and sculpture of the scutellum.

Public Museum, Milwaukee,
Oct. 26, 1905.

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